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RAILWAY EARNINGS FOR THE MONTH OF JANUARY, according to figures collected by *Bradstreet's*, show a very favorable increase over the corresponding month of last year. The reports of 143 roads show for Jan. 1890, gross earnings aggregating $31,497,203, on a mileage of 77,210 miles, against gross earnings aggregating $27,633,530, on a mileage of 75,582 miles, for Jan. 1889, an increase of 13.9 per cent. in earnings, and 2.1 per cent. in trackage. Only the Eastern roads show a decrease. The Granger roads show the most favorable results, the increase being 21 per cent. The favorable showing of the Southern roads, an increase of 17.3 per cent, notwithstanding the larger proportionate increase in mileage, speaks well for the industrial growth of that part of the country.

THE SENATE COMMITTEE ON PACIFIC RAILROADS has finally agreed upon a bill for adjusting the debt of the Union Pacific and Central Pacific railroad companies to the United States. The bill provides for ascertaining the present worth of this debt, and requires its payment, with 3 per cent. interest, in semi-annual installments. These are to be so arranged that the Union Pacific's debt would be extinguished in 50 years and the Central Pacific's debt in 75 years. The debt of the latter company is to bear interest at only 2 per cent., and this is to be capitalized for ten years while the company is getting on its feet. Ample provision is made for securing the debt by mortgages on all properties of the companies, and the difficulties under which the companies now labor with regard to building extensions are removed. In case the companies refuse to accept the provisions of the bill, it is provided that 75 per cent of their net earnings shall be placed in the sinking fund. In case of failure to pay, a receiver s to be appointed, with authority to take charge of and operate the road until the whole debt, principal and interest, has been paid.

CONCERNING ARGENTINE RAILWAYS, the Buenos Ayres *Standard*, of Jan. 1, says: Up to the present there are in working order and in course of construction 27 lines of railways, seventeen of which have national and ten provincial concessions. Their total length is 11,668 kilos., viz., 7,450 kilos. granted by the nation and 4,218 kilos. by the provinces. The guarantee several of these lines enjoy extends over a capital of $27,682,867 gold. Furthermore, 92 new concessions have been granted, embracing a length of 38,000 kilos. and a guaranteed capital of $312,541,900 gold. Of the 92 new concessions, 56 are national, with a length of 25,225 kilos., and 36 are provincial, with a length of 12,775 kilos. These figures are not complete, but they are near the mark. Of the 92 railway concessions applied for before the Congress of 1889, 45 were reported on favorably by the Department of Engineers. The length of railways working, in course of construction or conceded amounts to 49,668 kilos. The amount of capital guaranteed thereon reaches $440,224,767 gold. This figure, of course, excludes the capital of lines not enjoying Goverment guarantees.

THE PERUVIAN BONDHOLDERS' COMMITTEE have reported in connection with the GRACE contract with Peru made last November. The contract has been already noted, and the chief points of the committee report can be summarized as follows: The committee expects to get £925,000 from Chili, after paying off the Pisco-Yca bondholders, and from Peru a total annual income of $1,430,000 in the next three years, after deducting $400,000 to be allowed for that term to the Peruvian Government. The work contemplated is first the extension and repair of the seven existing Peruvian railway systems at an estimated cost of $3,212,000. It is then proposed to extend the Southern Ry. of Peru from Puno, its present terminus, on Lake Titicaca, to Desaguadero on the Bolivian frontier, by a narrow-gauge line, thus doing away with the transfer of goods at the lake. (2) To continue the line from Desaguadero to La Paz and to Oruro in Bolivia, at an estimated cost of $3,150,000. The existing revenue from railways is $630,000, which will also be available to the bondholders. Another concession in their hands empowers them to connect the Central Ry. system with the navigable waters of the Amazon by 180 miles of narrow-gauge road.

A CONSOLIDATION OF THE BALTIMORE & OHIO WITH THE NORTHERN PACIFIC has been rumored to be under way this week, and though there has been little to confirm the report, such an alliance would not be the strangest of occurrences. It would be much more likely, however, to take the form of an alliance similar to that made between the Union Pacific and the Chicago & Northwestern, than an actual consolidation. Should it be consummated, it would be the first through line under one management to extend from the Atlantic to the Pacific on American soil.

THE PROPOSED LEASE OF THE CHESAPEAKE & OHIO CANAL to the West Virginia Central Ry. Co. is the one topic in Maryland politics. The railway company bids $1,400,000 for a nominal lease of 99 years, renewable forever. While the Governor of Maryland approves of it, other parties claim that this newly-fledged railway company will obtain a right-of-way paralleling the Baltimore & Ohio R.R. at an exceedingly cheap rate. It gets 184 miles of practically graded roadbed, with expensive bridges, a tunnel costing a million dollars and much valuable property in the District of Columbia and at Cumberland. Eternal litigation is threatened if this bid is accepted.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision, Feb. 14, on the Louisville, New Albany & Chicago Ry., near Mitchell, Ind. The engine driver of a freight train instead of waiting on a side track for a passenger train to pass, started to reach Mitchell, thinking he could get there in time. The engine, baggage car and smoking car of the passenger train were wrecked. The wreck caught fire, but the flames were quickly extinguished. Three men were killed and about ten injured.——A rear collision occurred, Feb. 15, on the Cincinnati Southern Railway at Mellville, Tenn. A freight train was standing on a side track and a flagman had been sent back to flag a following freight. Instead, he flagged a passenger train and returned. The freight train backed onto the main track as soon as the passenger train had passed, and was run into by the following freight. Two men were killed.——Two misplaced switch accidents have occurred: on the Lake Shore & Michigan Southern Ry., at Bellevue, O., Feb. 13; on the Central Massachusetts R. R., at Ware, Mass., Feb. 15.

A DECIDEDLY REMARKABLE ACCIDENT is described by a daily paper as having occurred to a freight train Feb. 14, on the Union Pacific Ry., near Odessa, Mo.

"On account of unavoidable delays and through the absence of orders it was caught between stations and was running on the time of the fast mail train. The engineer of the freight tried to find a siding to crawl into to avoid a collision. The heavy Mogul was pushed to its utmost driving capacity. Coal was piled into the fire box, and the engine, responding to the will of the engineer, flew over the track at a speed never before attained by a freight train. Just before Odessa was reached the driving-wheels of the engine were melted, or burned off, and they left the rails, and the cars behind were piled upon each other."

Either the reporter must have had a fertile and imaginative mind, or else here is a new obstacle to obtaining high speeds. Railways cannot afford to run their engines at such a rate that the driving wheels will melt or burn off.

TWO LOCOMOTIVE BOILER EXPLOSIONS have occurred: On Feb. 13, the boiler of an engine hauling a passenger train on the Pittsburg, McKeesport & Youghiogheny R. R. exploded while near Douglas station, Pa. Two men were killed and three injured. The boiler of an Old Colony R. R. engine also exploded while hauling a passenger train near Roxbury, Mass. Nobody was injured.

A BRIDGE OR TRESTLE over Chisholm creek, near Wichita, Kan., on the Atchison, Topeka & Santa Fe R. R., gave way under a passenger train Feb. 17. One man was killed and five were injured. The supports had been burned away by tramps.

SPEED OF TRAINS WITHIN THE CITY LIMITS OF CHICAGO is to be reduced to 10 miles per hour, according to unofficial reports, to secure the repeal of a city ordinance prescribing that as a maximum speed. This is on the principle of GRANT'S saying that the best way to repeal a bad law is to enforce it. The move would meet such serious opposition from the dwellers in the suburbs, who depend on the railways for passage to and from business, that it is believed the obnoxious ordinance, which is now practically a dead letter, but which makes the railway responsible for many casualties at grade crossings, where it would otherwise escape, would be at once repealed.

The *Chicago Tribune* very sensibly points out that while the railways should not be forced to break the law in order to carry their passengers with reasonable dispatch, the permission to run at speeds up to 30 or 40 miles per hour should be granted to them only on condition that they agree to at once set about the work of removing grade crossings and providing flagmen for crossings not already so protected.

WHY FASTER TIME IS NOT MADE BETWEEN BOSTON AND NEW YORK is the subject of an investigation by the Railroad Committee of the Massachusetts Legislature. The order for the investigation was introduced by Representative JOSIAH QUINCY, who stated that the New York, New Haven & Hartford Co. was the chief corporation opposed to a reduction of time. This is the first instance in this country, so far as we recall, where the matter of too slow train service has been made the subject of a legislative investigation.

COMPULSORY AUTOMATIC CAR COUPLING is the subject of a bill presented to Congress by Representative FLOWER, of New York. The bill recites that, in view of the numerous accidents and loss of life resulting from the present system of coupling railway cars by hand, a bill requiring all railway companies to equip their freight and passenger trains with automatic couplers has become a necessity. The act is to be operative after Nov. 1, 1892. The Interstate Commerce Committee may in special cases extend the time one year longer. Failure to comply with the provisions of the act subject the offenders in each case to a fine of $500.

THE PNEUMATIC DYNAMITE GUN CO. has received an order from Great Britain for 50 pneumatic dynamite guns with air reservoirs, carriages, etc. The cost will be not far from $30,000 each. The order is conditional, however, on the satisfactory operation

of a trial 15-in. dynamite gun, soon to be shipped from here and tested at Shoeburyness. The gun, which is now at Cold Spring, N. Y., will be ready for shipment early next month, and preparations for its test are already going forward.

A LARGE CONTRACT FOR ELECTRIC RAILWAY EQUIPMENT was closed on Feb. 19, under the terms of which the street railways owned by the Minneapolis Street Ry. Co. and the St. Paul City Ry. Co., with a total extent of 110 miles, are to be equipped with the system of the Sprague Electric Ry. & Motor Co. The cable plants now in extensive use on the roads are to be discarded.

THE STANDARD ELECTRICAL SUBWAY Co. will probably soon have control of all the electrical ducts and subways in this city used for electric light and power, excepting the Edison ducts, in spite of vigorous opposition against the decision of the Board of Electrical Control to award the contract to this company. The Consolidated Telegraph & Electrical Subway Co. would still control the subways for telegraph and telephone wires. The latter company is stated to have already expended $2,000,000 on the subways constructed. Both companies claim a right to charge rentals equal to ten per cent. on the cost of subways, above expenses of operation and maintenance. With the wires thus divided an extra set of subways must be built; and, as a consequence, more streets torn up, says Commissioner GILROY.

THE ERICSSON COAST DEFENSE Co. is made the subject of a bill introduced into Congress on Feb. 15, asking that the Secretary of the Navy appoint a board of naval officers to inspect the plans and specifications of this company for constructing submarine guns and "detachable explosive rams." If the report is favorable, the Secretary is authorized to purchase, for $175,000, the gun and carriage equipped complete, ready for service. The bill also appropriates $1,500,000 for the purchase of ten or more of these guns should the test be favorable.

SHIPPING IRON FROM ALABAMA TO PITTSBURG seems somewhat akin to "sending coals to Newcastle." But it is done; and on Feb. 17, Sheffield, Ala., sent 5,000 tons by nine barges down the Tennessee and up the Ohio rivers. The barge freight was $2.50 per ton, which is so much less than by rail that it is said arrangements are being made to market the entire product of the five Sheffield furnaces by this route.

THE RIVER AND HARBOR ESTIMATE for the next fiscal year is $39,000,000, as figured by the U. S. Engineers. Mr. HENDERSON, Chairman of the House Committee on Rivers and Harbors, says, however, that he thinks this sum will be reduced to $25,000,000; but that is the lowest sum that can be recommended consistent with the work needed. New York State alone wants in round figures $2,250,000, the largest items being Harlem River, $500,000; removing obstructions in East River and at Hell Gate, $400,000; New York City, $160,000; Buffalo, $400,000; Hudson River, $150,000, etc.

THE MERCHANTS' RIVER FREIGHT LINE NAVIGATION Co. has been recently organized with headquarters at New York City. The company has been formed for the purpose of conveying freight from Pittsburg, Pa., to Omaha, Neb., and all intervening points on the Ohio, Mississippi and Missouri rivers. It proposes to carry freight at a minimum rate of 15 cts. per hundred pounds for all shipments of 1,000 lbs. and 25 cts. per hundred pounds for all consignments of less amount. To carry on the business a fleet of 60 light draught, extra fast freight steamboats, at a cost of $50,000 each, 300 flat-bottom barges at $3,500 each and warehouses at necessary points will be built.

WORK ON THE MANCHESTER SHIP CANAL was formally commenced on Nov. 11, 1887, so it has now been in progress a little over two years. In this period a total of 27,000,000 cu. yds. of all kinds of material have been excavated. At the present time nearly 100 steam excavators of all types are at work, 40 of which have been installed in the last year. Each machine employs 15 men, and assuming an average of 54 machines working during the two years, the average output of each has been about 926 cu. yds. per day. The total number employed during the past summer was 12,000 men and boys.

THE PANAMA CANAL is to be reported against by four of the French engineers sent out to examine it, says the New York *Herald*. These engineers are now in the United States on their way to Paris with their notes. They do little talking, but intimate that the Panama Canal is "but a bad dream," and one of them states that sufficient confidence can never again be aroused to raise the vast amount of money necessary to complete it.

THE PROPOSED JUNGFRAU RAILWAY, in Switzerland, is assuming a somewhat more tangible shape. Two plans have been submitted for the ascent of this peak, one by MORITZ KÖCHLIN and another by Mr. TRAUTWEILER, engineer of the St. Gothard and Brunig railways. The first plan is receiving the most favorable consideration, and includes a line 3¼ miles long, built either on the Mt. Pilatus rackrail system, or to be divided into five sections of cable-line worked by water power. A reservoir on the summit, supplied by pumps from below, would furnish the power. Mr. TRAUTWEILER proposes a covered road throughout, to escape climatic influences. He would build four sections of a large pipe conduit and operate it by cable with compressed air as a motive power; the air to be compressed by water power. Mr. KÖCHLIN'S estimate of cost is $1,950,000; and Mr. TRAUTWEILER wants $1,150,000.

THE COST PER FOOT OF SPACE in Machinery Hall at the Paris Exposition was $2.18 per square foot of space covered, says Mr. OCTAVE CHANUTE, C. E., in a late address before the Western Society of Civil Engineers. This was less than that of an ordinary wooden cottage in Chicago, but it was about two and one-half times as much as the cost of the buildings adjoining the great Machinery Hall of M. DUTEXT. The Fine Arts Palace and the Liberal Arts Palace, designed by M. FORMIGE, cost $3.09 per square foot of floor space, but these buildings were practically two stories in height. Mr. CHANUTE says that the French authorities have decided to retain the Machinery Hall, the main transept and central dome, as well as the Fine Arts and Liberal Arts buildings. They do this because the experience of 1878 taught them that to sell the old material was simply to sacrifice it.

THE WORLD'S FAIR BILL has passed the Albany lawmakers at last, and the unseemly political squabble over a matter that should not be in politics at all, seems to be over. As a consequence of this settlement of differences between party leaders, the prospects of the Fair before Congress are much improved.

THE GRAND PACIFIC HOTEL in Chicago, one of the finest hotels in America, and a model high-class establishment with overflowing patronage, is to be torn down and replaced by a business block. The reason given is that the rent is based upon the value of the real estate, and this has increased to such an enormous sum that as a hotel the property is actually worse than non-productive land. The hotel cost $800,000, and was sold on Feb. 8 for $40,000 to Mr. LEVI Z. LEITER, who owns the ground. Three or four ordinary high buildings must now be piled one on top of the other to yield interest on the real estate value.

THE NORTH RIVER BRIDGE BILL, now before the Senate, has been reported upon favorably by the War Department, though General CASEY suggests amendments in certain particulars. Only two of the proposed amendments are important, one of which provides for "towers instead of piers," an apparent distinction without a difference. As amended, this section also prescribes a clearance under the bridge of 145 ft. at the towers and 155 ft. at the centre of span. The War Department also suggests a new section in the bill, requiring the submission of plans satisfactory to the Secretary of War, within one year after the passage of the bill, and that the contract for construction shall be given out one year after the approval of plans by the Secretary, and the bridge shall be completed within 10 years of such approval; otherwise the provisions of the act shall be null and void.

The Cable Railway Tunnel Under the Chicago River, Chicago, Ill.

(WITH INSET.)

In our issue of Dec. 7, a short account was given of the tunnel now under construction under the Chicago River, at Chicago, Ill. Through the courtesy of Mr. SAMUEL G. ARTINGSTALL, C. E., the Chief Engineer, we are now enabled to present sections and the plan and profile of this interesting work.

The tunnel is being built by the West Chicago Street Railway Company, and as shown is being fitted for double-track cable traction. It crosses the Chicago River about 150 ft. north of Van Buren Street (see Fig. 1), and at the shore ends it passes under several large buildings requiring underpinning and essentially new foundations over the tunnel. The plan and profile show with sufficient clearness the general position of the tunnel with reference to the river and adjoining streets and buildings.

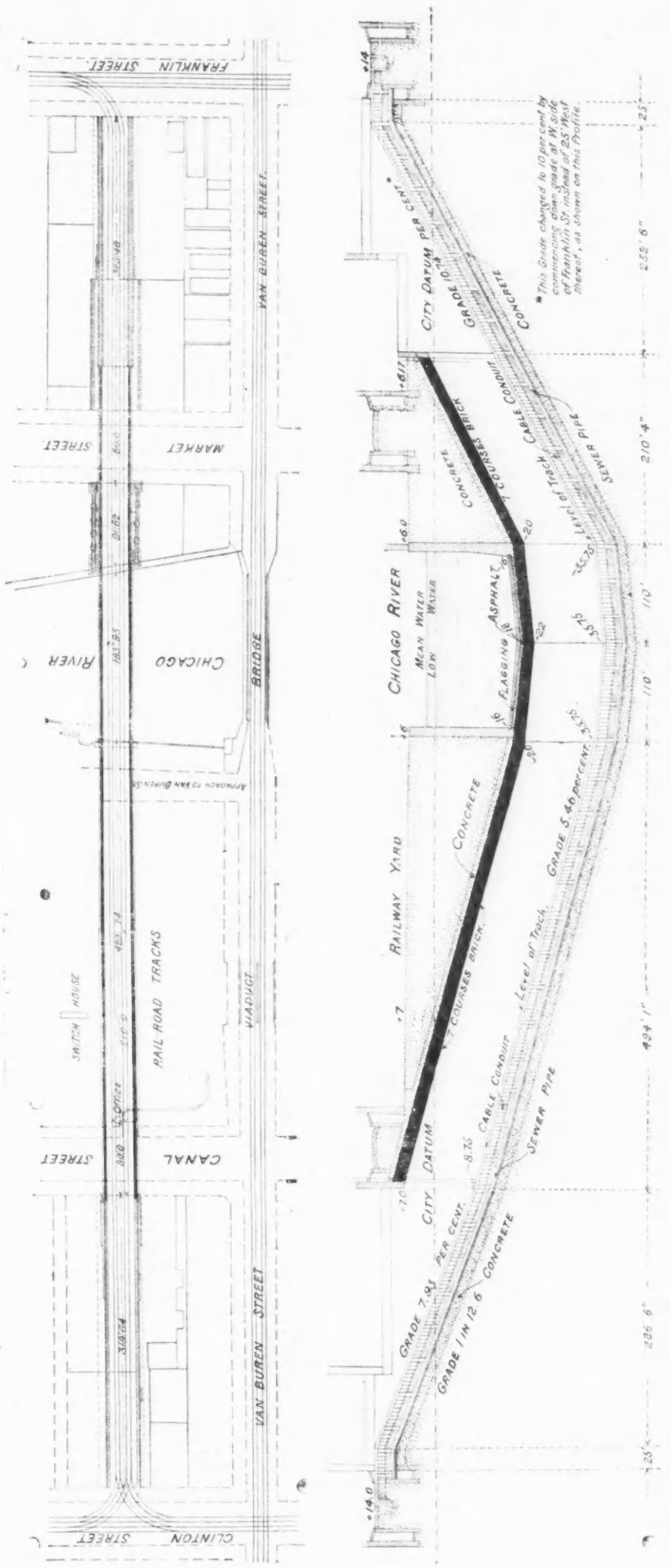
The tunnel will be lined with hard-burned brick laid as hereinafter described. Utica cement is specified for use when natural cement is to be employed. The concrete, however, is to be made of Portland cement mortar, with sand, and broken limestone in cubes not exceeding 3 ins. in any dimension. The concrete mortar will be one part cement to three parts sand by measure, and to this mortar six parts of the broken stone is to be added. This concrete is to be spread in successive 4-in. layers and thoroughly rammed with rammers 4 ins. in diameter and weighing not less than 20 lbs. each. The face stone, when used, is to be "Buff Bedford," with beds and joints planed or bush hammered, and the rubble stone will be Joliet limestone as large in size as possible.

The tunnel, from the west line of Franklin to the east line of Clinton St., will be 1513 ft. long with the dimensions shown on the several sections. The gradients are given on the accompanying profile. The line is located upon private property, and besides passing under the buildings before referred to, also crosses under the tracks of the Pittsburgh, Fort Wayne & Chicago R. R., the Chicago & Alton R. R., and the Chicago, Burlington & Quincy R. R. on the approach to the Union Depot.

The contractors for building the tunnel are responsible for the safety of the buildings, etc., under which the tunnel is driven. The contract generally specifies that before any work on the tunnel is commenced, all buildings must be underpinned by extending the foundations downwards below the level of the tunnel bottom according to such plans as the engineer may devise and the conditions demand. All trenches are to excavated in short lengths and securely supported by close oak sheeting, struts, braces, etc.; this sheeting shall be caulked in such places where water may be troublesome, or there is any liability of settlement by escape of semi-liquid material.

The Springer Building, between Clinton and Canal streets, will have its west front supported on steel girders resting on stone piers, with footings of Joliet limestone. The east front will be carried on steel girders resting on piers built of Anderson pressed clinker or Brand brick laid with very close joints in Utica cement mortar; concrete foundations will support these piers. The second floor of the building, and the first floor on Canal street, will also be carried on steel girders resting on common brick walls carried clear to the second story and supported on the side walls of the tunnel approach.

The Altgelt Building, between the river and Market street, will require especial care in supporting it during the progress of the work. The river and Market street fronts will be carried on steel girders on Anderson brick piers, laid in Portland cement mortar. The foundations under the piers on the river front will be of concrete, 10 by 20 ft., capped at the dock line with Bedford stone, 2 ft. thick. The Market street piers will be of brick and a concrete base. The side walls of the building will be supported on cast-iron cylinders, indicated in the plan. The cylinders on the north side will be 6 ft. in diameter, and those on the south side 7 ft. in diameter, with metal 1⅛ ins. thick, and 4½ ins. internal flanges, bolted together by 1⅛-ins. bolts, spaced 5 ins. apart. These cylinders will be sunk by excavating the earth inside and forcing them into the ground. They will be located under the centre of the wall, filled with concrete after the base has reached firm bottom



Plan and Profile of the Cable Railway Tunnel under the Chicago River.—SAMUEL G. ARTINGSTALL, Engineer.

below the tunnel level, and each capped on top by a granite block, 2 ft. thick by 4 ft. wide and 6 or 7 ft. long. Between these cylinders will then be turned brick arches, backed and underpinned to existing walls by brick masonry of Anderson clinker pressed brick, laid in Utica cement mortar in an alternate header and stretcher bond.

After these cylinders are in place, and the walls of the building secure, the floors will be supported by temporary trusses until the tunnel is finished. After this the cast iron columns supporting the floors will be replaced on piers of concrete and timber cribwork, as shown at the bottom of the inset illustration. This cribwork will be used for the purpose of distributing the weight over the surface of the tunnel while the concrete is wet. If sufficient time can be gained before the load is applied its use will not be necessary.

The open approaches will be faced with Bedford stone in regular courses ranging from 2 ft. to 18 in. in depth, and laid with an alternate header and stretcher bond. The backing will be of Joliet limestone in courses of the same thickness as the face. Portland cement is alone to be used in this portion of the work, and the foundations below them will be of Portland cement concrete.

The tunnel portal will be made of Bedford stone, as shown in the elevation on inset illustrations. The tunnel proper will be of brick masonry, in seven rings, or 32 ins. thick; excepting a length of 210 ft., under the railway tracks, where the thickness is increased, as shown on the drawings. The bricks will be laid longitudinally with the tunnel, with edges toward the centre and toothing joints. The joints must be perfectly filled by pressing the brick into the mortar, and not made by attempting to force mortar between the bricks. The joints between courses shall not exceed one-half inch in thickness, and between the rings the joints shall not be less than one-half inch.

The tunnel masonry will be laid generally in Utica cement mortar. But the bricks in the three outer rings, under the river and for 100 ft. on each side, a total distance of 420 ft., and in the two outer rings in the rest of the tunnel, will be laid in and grouted with asphalt cement mortar. This mortar is to be made of pure Trinidad asphalt and gypsum, with generally one part asphalt to three parts gypsum; to be mixed on the ground and furnished hot, ready for use in small quantities as required. No remelting of set or cold asphalt mortar is permitted. The invert, the backing and the filling over the haunches and crown of the tunnel will be Portland cement concrete, well rammed in place.

For the river section the top of the concrete filling will be covered with one inch in thickness of asphalt mortar, made as before described, and in this will be imbedded large flagstones, 12 ins. thick, with the joints grouted with asphalt mortar. The dock walls are to be built of Portland cement concrete, faced with Bedford stone in 2 ft. courses, and surmounted by a coping 2 ft. thick by 8 ft. wide.

Under the centre line of the tunnel, there will be a 12-in. drain pipe, with man-holes for cleaning 200 feet apart. Drain tiles, 4 ins. in diameter, will also be laid outside of the tunnel and about 50 feet apart, and these will connect with 4-in. cast iron pipe leading to the main drain. The main drain discharges into a sump on the east side, at which point there is a drainage pump and a 6-ft. brick well leading to the surface.

The river portion will be built in a coffer dam, one-half at a time, and the specification requires the contractor to provide at all times a free and open channel for vessels. The contractor will not be permitted to draw any piles, sheeting, etc., used in this portion of the work, but he must remove all obstructions and cut off all timbers at least 18 ft. below city datum.

The plans for this tunnel have been prepared by Mr. SAMUEL G. ARTINGSTALL, C. E., who is the engineer of the work. The contract for building, which has just been let to Fitzsimmons & Connell for the sum of $750,000, calls for its completion by Feb. 1, 1892. This contract does not include the paving, tracklaying and filling over the invert under the tracks. Work has already been commenced on the coffer dam at the west end of the tunnel at Clinton street. Mr. CHARLES WESTON, who has been appointed resident engineer, was lately resident engineer of the Lake View tunnel under Lake Michigan and Mr. H. LEACH has succeeded him in that work

Performance of the Best Modern Pumping Engines, Compared to that of the Cornish Pumping Engines in the Period of 1840.

By Prof. J. E. DENTON, Stevens Institute of Technology.

(*Concluded from page* 124.)

INFLUENCE OF STEAM JACKETS.

The engine was worked for 6 hours and again for 9 hours without the presence of steam in the jackets but with the flue reheater in action. The coal consumption was not determined, the steam consumed, as shown by the feed meter, being the desired measurement. For 6 hours the total water consumed was about 180 cu. ft. The level of water in the boilers could be made the same at the beginning and end of the test, within ⅛ in. Thereby, the maximum error of water determination would be, for three boilers, about ½ of 1 per cent. No practical error is involved, therefore, in basing conclusions upon so short an interval as 6 hours. Table IV. shows the principal results compared with those obtained with the jackets in use. Column 14 gives the steam consumed per hour per H. P. There is apparently a gain in economy by the use of the jackets, the consumption being 13.62 lbs. with their use, and as high as 14.17 lbs. without them.

But the differences in cut-off in the high-pressure cylinder represent differences of consumption, which theoretically may cause the variations in economy. Furthermore, the probable error in mean pressure determinations from the indicator cards may be 2 per cent. It is not possible, therefore, to conclude that the differences of economy shown in column 14 are entirely attributable to the influence of the jacket. As a probable result, the average of the two tests, with and without the jacket, may be compared. This basis makes the gain in economy due to the jacket equal to about 3 per cent. Inasmuch as the complete drainage of the jackets is regarded as important in temporarily dispensing with the use of the latter for the purposes of a test, the following explanation is made regarding the steps taken to insure the emptiness of the jacket spaces when the latter were not supplied with steam. The pipe supplying the steam to the jacket is 1 in. in diameter. It connects with the jackets at the bottom of the cylinders, and there are no obstructions to prevent condensed water from flowing by gravity from the jackets into the well of the jacket pump, situated about 1 ft. below the bottom of the cylinders. When the jacket is supplied with steam, a "straight way" valve on the 1-in. pipe is wide open to admit the steam from the boiler.

When the test without jackets was made, this valve was closed, and then a 1-in. valve on the same pipe connecting with the waste pipe was opened wide, thereby causing the jacket spaces to be violently blown free of all water then in them. The connection between the jacket pump and the boiler feed pump was then closed by a globe valve, and the delivery side of the pump opened to the atmosphere. The pump remained in action and the blow-off valve remained open during the tests. The latter were not commenced until the engine had been running about an hour under the above conditions.

Table V. compares the theoretical steam consumption of two of the four tests. Columns 10 and 11 show that 88 per cent. of steam at release in high-pressure cylinder appears at cut-off in low-pressure cylinder with the jackets, and 84 per cent. without jackets. The re-evaporation is about 8 per cent. of the total consumption in both cylinders with the jacket and about half as much without the jackets. The difference of re-evaporative effect with the jacket in use represents just about the steam condensed in the jackets. This fact can hardly be regarded as proven, however, so far as the indicator cards are concerned, for the latter do not show any uniform difference in the law of the expansion line with and without jackets, respectively. This is evident from Fig. 31, in which the dotted points between the lines *S S*, S_1, S_2, etc., represent the expansive lines of different indicator cards reduced to the same cut-off and length, all high cards passing through *A* and all low cards through *P*.

The indicator cards were taken with all ordinary care and skill, and with a truly parallel motion—a pantagraph or Corliss lazy tongs (see Fig. 16) being used. But no precautions were taken to eliminate the finer elements of error in the drum* motion. Consequently the length of cards differed over a range of 2 per cent. in about 5 ins. Such error is not important for most other deductions, but it is inadmissible where such a refinement as the influence of jackets is to be studied. Arrangements are now being made to obtain cards with and without jackets in use, by the use of more perfect indicator drum motion.

GENERAL CONCLUSIONS.

In the performance of the Pawtucket engine, modern engineering may claim to have accomplished the saving of about 23 per cent. of the best steam or coal consumption which can be possibly accredited to the famous Cornish engines during the period of their greatest success, half a century ago.† But a much more impressive difference appears in the relative magnitude of these two types of engine.

Thus the Wicksteed engine, with a capacity equivalent to 3,000,000 galls., against 210 ft. of head, weighed 250 tons exclusive of foundations, while the Pawtucket, with a capacity of 3,000,000 galls., against 270 ft., only weighs 60 tons.

The relative dimension of foundations and space occupied is also proportionately in favor of the Pawtucket engine.

In the matter of weight and expense of foundations, etc., however, the type represented by the Pawtucket engine does not afford the best possible results.

In it, as in the Cornish engine, a portion of the power of the steam is stored as kinetic energy in a moving mass. By making such mass consist mainly of the fly wheel, whose velocity is a multiple of that of the piston, much less weight is necessary for the storage action than when the same energy is lodged in a mass consisting of a slowly moving piston and beam, as was the case in the Cornish engine. But in the Worthington pumping engine the steam is applied expansively without the use of either heavy reciprocating parts or a fly wheel. Power is alternately stored and restored, but the device by which this is accomplished practically dispenses with forces of inertia, and adds no more to the weight of the steam and pump cylinders than is represented by the crosshead, lower connecting rods, and vibrating levers of the Pawtucket engine.

An almost perfect equilibrium is maintained between the water pressure and the pressure of steam expanded throughout a large range of volume.

It is not necessary to enter here upon the details of the principles by which this equilibrium is accomplished, as the matter has been made familiar to engineers in recent publications; but it should be stated that even at the comparatively slow piston speed of about 120 ft. per minute, a Worthington high duty pump of 3,000,000 galls. capacity against 210 ft. of head would weigh only 41 tons (about the weight of the plunger alone of the Wicksteed engine), and could almost dispense with foundations if desired.

With 100 lbs. boiler pressure and a ratio of expansion of about 12, the Worthington high duty pump has proven its ability to produce 1 H. P. with 17½‡ lbs. of steam, or a duty of 100,000,000 ft. lbs. per 100 lbs. of coal at about 9.4 lbs. evaporation.

At this duty it is a close question whether the interest, depreciation, etc., upon the value of the difference in weight of the Worthington compared

* See discussion of such errors in paper by J. B. WEBB. ENG. NEWS, Dec. 28, 1889.

† *Vide* "Measurements of Steam Consumption of Modern Cornish Pumping Engines," by J. G. MAIR, Trans. Brit. C. E. Vol. LXX.

‡ *Vide* report of Prof. UNWIN on the Performance of the Worthington Engine in Europe.

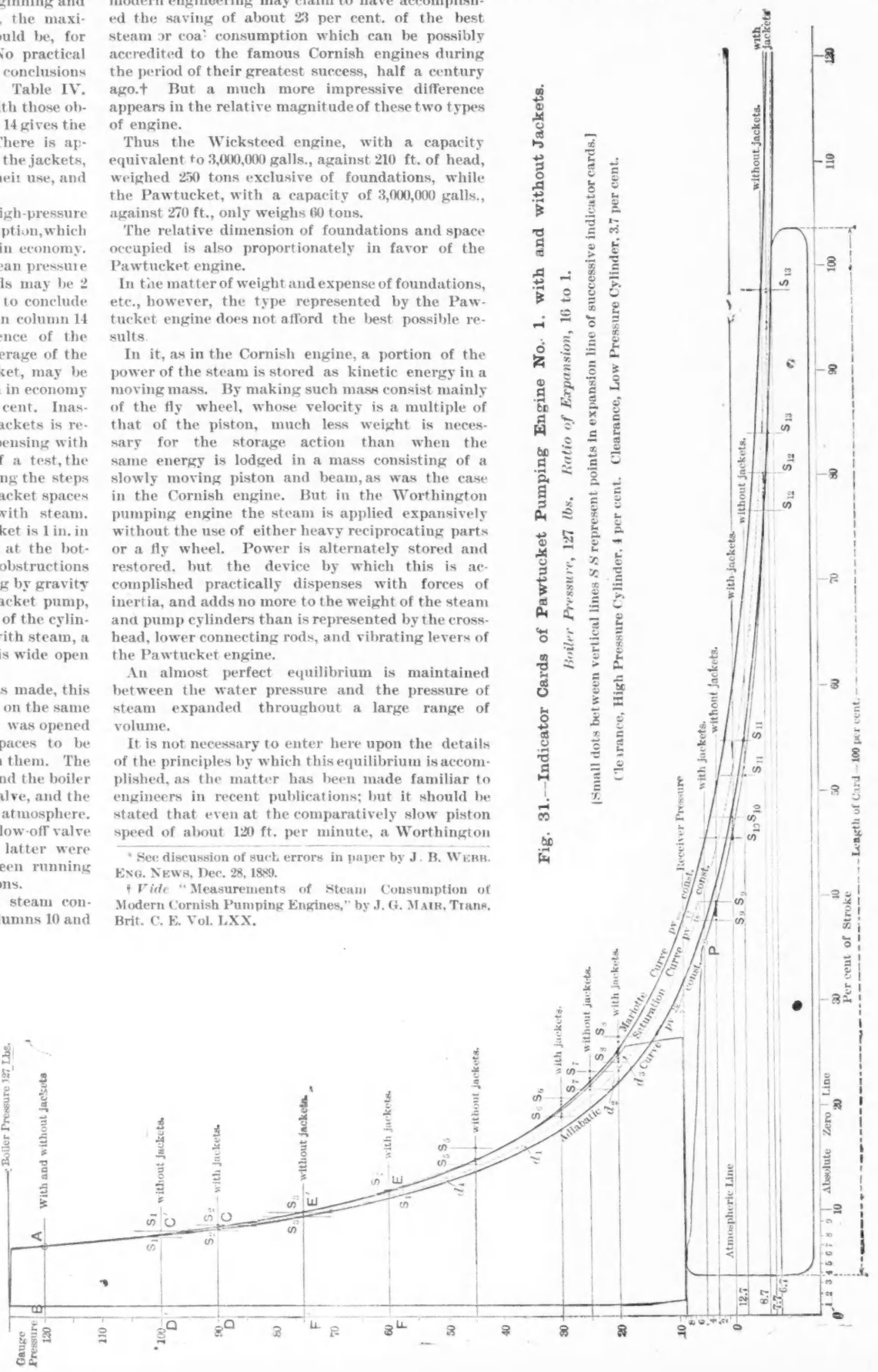


Fig. 31.—Indicator Cards of Pawtucket Pumping Engine No. 1. with and without Jackets.

Boiler Pressure, 127 lbs. Ratio of Expansion, 16 to 1.

[Small dots between vertical lines *S S* represent points in expansion line of successive indicator cards.]

Clearance, High Pressure Cylinder, 4 per cent. Clearance, Low Pressure Cylinder, 3.7 per cent.

to most fly-wheel pumps, does not offset the coal saved by 20 per cent. greater duty; such a view would apply without exceptions should the piston speed be made equivalent to that in the Pawtucket engine, as it may be so far as mechanical principles are concerned.

Meanwhile the success which has already attended the use of the high duty attachment has won for it not only the admiration of American engineers, but a degree of appreciation in other countries of which Americans may be justly proud.

The steam economy attained with the Pawtucket engine, namely, 13¾ lbs. of steam per hour per I. H. P., has become an accepted fact in American mill practice with two cylinder compound engines using steam at about 120 lbs. boiler pressure, and expanding it about 18 times. The latter type of engine is now beginning to find competitors in triple and quadruple expansion types.

At present we have no exact knowledge of the amount of improvement in economy which these types afford. The great 3,000 H. P. quadruple expansion engine at Warren, R. I., has as yet only half of its intended load, and is therefore not worked at the boiler pressure which should best develop the advantages of the four cylinders.

A plant which may fairly be regarded as probably embodying the most advanced principles of economy is the 900 H. P. triple expansion engine at the Richard Borden Mfg. Co.'s Mills, Fall River, Mass.

In this two low-pressure cylinders 36 ins. diameter and 5 ft. stroke, work cranks at right angles at the ends of the fly-wheel shaft. On the same piston-rod with one of the low-pressure cylinders is the high-pressure cylinder, 20 ins. diameter. This exhausts through a receiver to the intermediate cylinder, which is 34 ins. diameter, and is on the same piston rod with the other low-pressure cylinder. Thus a 20 in. cylinder exhausts into a 34 in. and the latter into two 36 in. cylinders simultaneously. The governor controls the cut-off in all four cylinders. Jackets on each cylinder act as the steam chest to that cylinder.

The steam exhausted from the intermediate cylinder passes in contact with a coil of pipe containing steam of boiler pressure. The feed water from the hot-well, together with all the condensed steam from the jackets and receivers, is passed through heaters in the flue leading to the chimney, thereby absorbing heat from the gases of combustion which would otherwise escape to the atmosphere. Finally the chimney gases pass over flues through which a Sturtevant fan draws air from the atmosphere, which is used to heat the cotton mill to which the engine supplies its power. The chimney is provided with about 50 per cent. greater draught capacity, in view of the extent to which the temperature of the gases are reduced. This plant is to use steam at 150 lbs. boiler pressure, and expands it about 18 times. The engine runs at 65 revolutions per minute.

It is expected that the increased economy to be derived from the engine will demonstrate that the decrease in the first cost of boilers will equal the cost of the two extra cylinders which the triple principle requires.

For the first time in the history of engineering it is probable that the highest developments in steam economy are not presented in pumping engines, for although the triple principle has been applied to pumps, the latter do not attain the high speed of revolution present in the mill engines. If, however, certain expectations of great possibilities of increase of piston speed in pumps by positively closing valves be well founded, we may expect to see pumping engines again in the lead, as, other things being equal, the uniform conditions of load available in pumping afford better average economy than is attainable in other classes of steam service.

TABLE IV.

Steam consumed by jackets—107 lbs. per hour. Clearance of high-pressure cylinder = 4 per cent. of piston displacement. Clearance of low-pressure cylinder = 3.7 per cent. of piston displacement. Ratio of volume of cylinders = 4.085.

Duration of test. Hours.	Condition of Test.	Boiler pressure gauge. Lbs. per. sq. in.			Water pressure against pump piston, including suction. Lbs. per sq. in.			Revolutions per minute.	Average cut-off in percentage of stroke, clearance not included.		Indicated horse power.	Steam consumption. Lbs. per hour.		Steam condensed, calculated from cards.		Mean effective pressure. Lbs. per sq. in.		Vacuum.	Average back pressure.
												Actual measurement.							
		Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.		High cylinder.	Low cylinder.	I. H. P.	Total.	Per I. H. P.	In cylinder during admission. Lbs. per hour.	Per cent. of total feed water.	High cylinder.	Low cylinder.	Inches of mercury.	The pressure. Inches.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
72 / 24	With jacket.....	127 / 128	125 / 125	130 / 130	115 / 116	114 / 115	116½ / 117½	49.63 / 49.50	0.220 / 0.235	0 3100 / 0.3355	143.49 / 147.95	1958 / 2046	13.62† / 13.82†	453 / 460	23* / 22½*	59.5 / 61.8	12.60 / 12.65	28½ / 28½	1.25 / 1.25
6 / 9	Without jacket....	125 / 124	124 / 120	127 / 127	116½ / 118	115½ / 117	117 / 120½	40.40 / 48.95	0.216 / 0.258	0.3350 / 0.3500	148.37 / 149.74	2070 / 2122	13.95 / 14.17	586 / 551	28 / 26	62.0 / 63.5	12.70 / 12.85	28½ / 28½	1.25 / 1.25

Av. Barometer, 30.00 ins. *The 5 per cent. of steam condensed by jackets is not included in these figures. †The 5 per cent. of steam condensed by jackets is included in these figures.

TABLE V.

STEAM CONSUMPTION, PER INDICATED HORSE POWER, CALCULATED FROM INDICATOR CARDS.

Cylinder	Pressure in lbs. per sq. in. absolute		Percentages of Stroke (Including clearance.)						Theoretical water consumption, pounds per hour per H. P.		Mean Effective Pressure.				Conditions of Tests.
			High cylinder.				Low Cy'lder				High Cyl.		Low Cyl'der		
			Near cut-off		Near release										
	Near cut-off.	Near release.	Actual.	Actual divided by ratio of cylinders.	Actual.	Actual divided by ratio of cylinders.	Near cut-off. Actual.	Near release. Actual.	Near cut-off.	Near release.	Actual.	Actual divided by ratio of cylinders.	Actual.	Total mean pressures reduced to low cyl. Sum of columns 13 and 14.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
High cylinder.	134 7	39.7	25.99	6.37	90.00	22.06	.....	.....	9.86	10.87	59.5	14.58	.....	27.18	With Jacket. 72 hour test.
Low cylinder.	19.7	7.7	.....	.....	.....	.....	34.0	93.7	8.78	9.76	.....	.....	12.60		
High cylinder.	134.7	39.7	29.01	7.11	96.49	23.65	.....	.....	10.53	11.08	63.5	15.56	.....	28.41	Without Jacket. 9 hour test.
Low cylinder.	19.7	7.7	.....	.....	.....	.....	38.7	99 9	9.36	9.96	.....	.....	12.85		

Notes on Foreign Highway Construction and Maintenance.

Among the English "Blue-Books" is one giving a series of reports on "The Construction and Maintenance of Public Roads in European States." This is an inviting title to American readers at this time, but the reports have been unfortunately made by "Her Majesty's representatives at European Courts," and not by engineers, as is evident in the wealth of statistical information contained therein with a corresponding dearth of the more valuable practice. But a number of points of interest to road commissions and engineers can be found in the reports, and these are abstracted as follows:

Austria.—Public roads are divided into two distinct classes, imperial, or State roads, and roads under local control. The first are constructed and maintained at the expense of the State under the Minister of the Interior, and employ a large technical staff. There is also a technical headquarters in every province under the governor of that province. Part of the expense is met by the collection of tolls. The construction varies much in character, and the older roads are usually without solid foundations. The material used in mending them is generally too soft, and comparatively few roads are really up to modern standards. The total length of State roads in Austria in 1882 was 9,475 miles; but the percentage of macadamized roads is lower than in Germany, France, Italy, or England. The decree of 1843 made 30 ft. the maximum width; but the maximum is now 39.36 ft. (12 m.).

The Austrian Government is now paying much attention to road construction. At one time most of the work was done on nine-year contracts; the contractor receiving a certain sum for the material required and also for repairs to bridges, but the actual wages of the road-cleaners were paid by the Government. The fault of this system was that the road-cleaners, paid by the State, were dependent upon the contractors for their places, and, moreover, it was impossible to make any probable estimate so many years in advance of the work required. The Government now does all the work under its own duly-appointed officials.

Each road-cleaner is now held responsible for the care of 2.8 miles of road, and for this he is paid from 87 to 812 per month in a depreciated currency. They are allowed extra help in the spring and autumn months. Each road inspector has 22½ miles of highway under his charge. The method of repair now adopted as the most economical and practicable is to lay down a large amount of material on the roads in spring and autumn; to continually repair all defects and to clear off all dust and mud by scrapers. A patch system (*point-a-temps*) had been tried, but given up as too costly in labor. By this plan the road was cleared of all dust and mud, ruts, wheel tracks and other depressions filled with gravel, and the soil around the damaged part also loosened and afterwards rammed so as to consolidate the old and new work and form a smooth, even surface. The toll charged on the State roads per Austrian mile (4.7 English miles) is about 1 cent for a wagon and two horses, ½ cent for a one-horse team, ¼ cent per head

for horses and cattle. Bridge toll is about three times this sum, varying with the class of bridge.

Public roads not under State control are classified as:

(*a*) Provincial roads—*Landes Strassen.*

(*b*) District roads—*Bezirks Strassen.*

(*c*) Municipal roads—*Gemeinde Strassen.*

(*a*) Provincial roads are constructed and maintained at the expense of the province, which settles all matters relating to them, and has power to levy rates and taxes for this purposes. They are administered by a standing committee of the Provincial Diet.

(*b*.) District roads are under the care of a committee of 5 to 15 members, elected for three years by the district. The highest tax-payers and one member of the Provincial Diet are on this committee, and their expenses only are allowed. The cost of construction and maintenance is provided for by a tax levied in proportion to the amount of direct tax paid by the inhabitants; but this committee must obtain the consent of the Provincial Diet for anything in excess of 15 per cent. of the total local taxation. In the poorer districts the Provincial Government assists by advances from a fund provided, or by loans without interest.

The cleaning and repairing of both provincial and district roads is done by regularly appointed men, who have each from 1¼ to 2½ miles in their charge. A certain number of day laborers are allowed them as required. The regular official road-cleaner receives from $10 to $15 per month, and has a claim for a small pension in his old age. Each district has its engineer, who is appointed by the provincial authorities, and he superintends all work of importance, such as constructing roads, building bridges, etc.

(*c*) Municipal ways are built and maintained by the communities, and are under the control of the municipal authorities, though special grants are sometimes made by the Provincial Diet for this purpose.

These roads are classified by a decree of the Provincial Diet, according to their importance, construction, or position. According to the legal definition, provincial roads connect together the important points in the province; district roads run between smaller towns and connect them with the provincial roads, and municipal roads are wholly within the municipalities or towns.

The provincial and district roads, according to the law, should be macadamized and be 19.7 ft. (6 m.) wide, excluding the space for side ditches and tree planting. The centre of this road is to have a foundation of broken stone 6 to 8 ins. deep, and a covering of 6 ins. of gravel, with side slopes of 1 in 18. But owing to the expense involved this method is only followed in new road building or on much used roads; in the older roads the foundation of broken stone is almost always omitted. The law also calls for the planting of trees at intervals of 66 ft. apart along roads of this class. Bridges, walls, etc., are very substantially constructed. The total length of provincial, district and municipal roads is 5,104 miles, and on these roads are 1,150 bridges of brick, 266 of stone and 1,622 of wood; the latter are being replaced as rapidly as possible by iron and masonry.

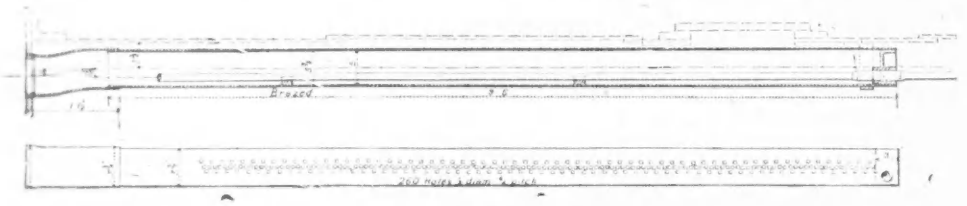


Fig. 1.—Express Locomotive, Southeastern Railway (England)—Section and Plan of Steam Pipe.

For 1882, the average cost of maintenance of provincial roads per kilometre (.62 miles) was $386.76 in Austrian currency. The average cost for maintaining district roads was $149.76 per kilometre.

(TO BE CONTINUED.)

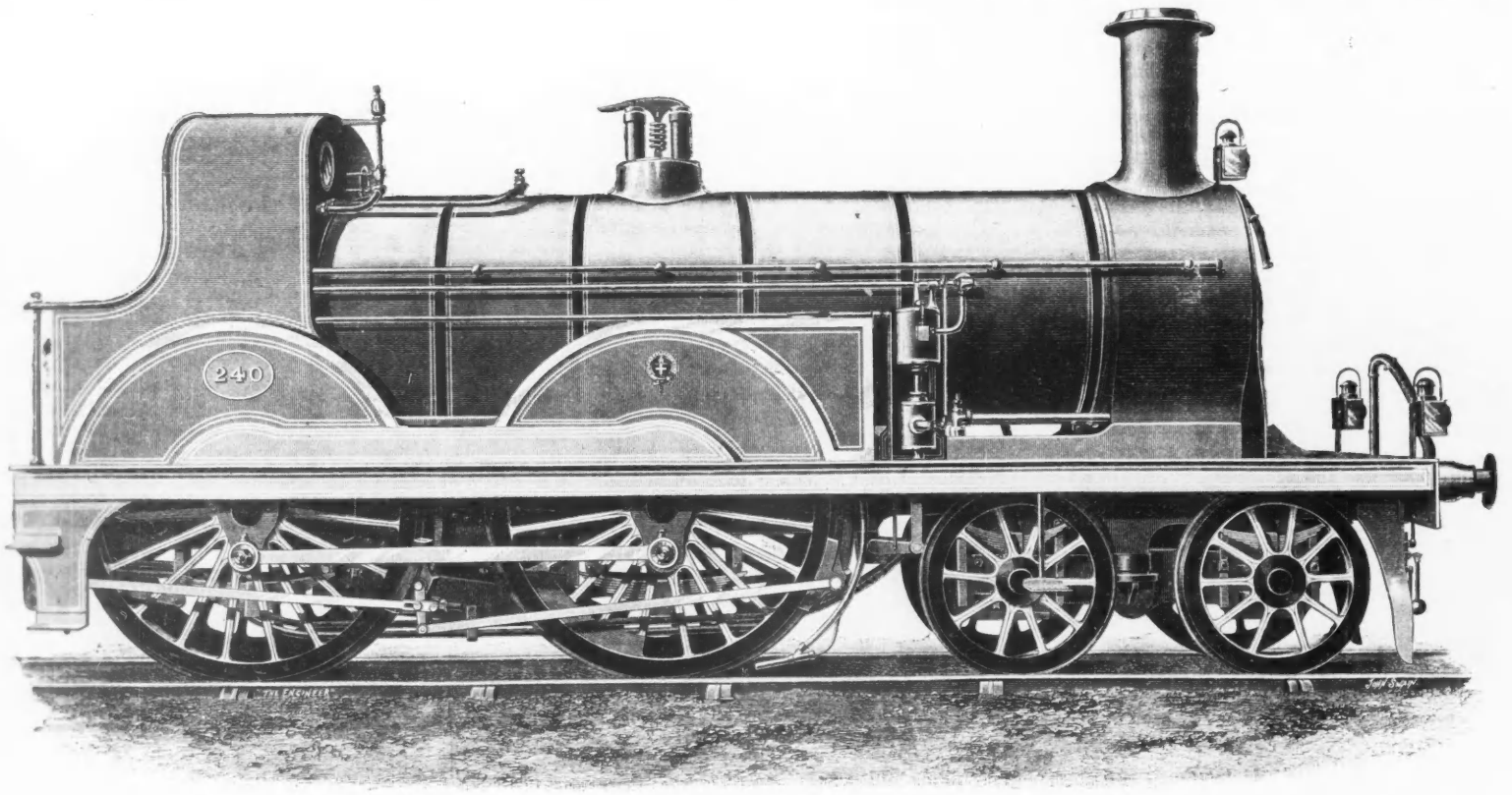
Express Locomotive.—Southeastern Railway of England.

We have from time to time published, and shall continue to publish, views and particulars of different classes of locomotives used on foreign railways. There is a decided tendency abroad, as we have already stated several times, to conform in many important features to American standard practice. This tendency is especially noticeable in modern English locomotives, and it is certainly on the increase, both in engines built by the railway companies and in those built by locomotive works for home or foreign service.

The engine which we illustrate this week is a fine express engine built last year by the Southeastern Ry. Co. at its works at Ashford, and was sent to the Paris Exhibition. After the close of the exhibition it was put in service on one of the French railways. It was built to the designs of Mr. JAMES STIRLING, M. Inst. C. E., Locomotive Superintendent of the road. Our illustration is reduced from an inset sheet in *The Engineer*, London, Jan. 3, 1890.

The general type of the engine is similar to the standard American "eight-wheel" type, having four coupled driving wheels and a leading four-wheel truck. The driving wheels are 7 ft. diameter, and the truck wheels 3 ft. 9⅛ ins. The sizes of all the wheels, while in accordance with ordinary English practice for fast service, are considerably larger than is common in this country, even for our fast locomotives. While the engines would probably be slow in starting, the large wheels are best for fast running, and English express trains have comparatively long runs without stopping, and are not obliged to slacken speed for grade crossings, etc., as in this country. Nearly all crossings are over or under the railway.

The engine is fitted with power brakes on the driving wheels, and with the Westinghouse train brake. Sand is applied by a jet. The lamps on the smoke-box and buffer beam are merely to indicate to the signalmen, etc., the number of the train and its destination. One of the most noticeable features of the engine is the absence of a dome, the steam being taken from a pipe, with perforations on its upper surface, suspended by hangers inside the top of the boiler barrel. This pipe and the throttle valve rod are shown in Fig. 1. There is said to be no trouble from priming.



Express Locomotive, Southeastern Railway (England).—Engineer, Mr. JAMES STIRLING, M. Inst. C. E.

The truck, shown in Fig. 2, swivels and radiates at the same time. The 4 in. steel pin, seen to the left in the sectional elevation, is secured to the truck frame casting, and round this pin to the right and left the truck traverses, the swing to either side being about ¾ in., or a total swing of 1½ ins. The other pin is fixed on the engine frame and is in the centre of the truck when the latter is in its normal position. The india-rubber springs arranged diagonally as shown, exert their influence to keep the truck in the normal position. The object of putting the retaining bolts at an angle is to lessen the amount of compression on the rubber for a given lateral traverse. This truck is said to give perfect satisfaction, the motion being at once easy and resil-

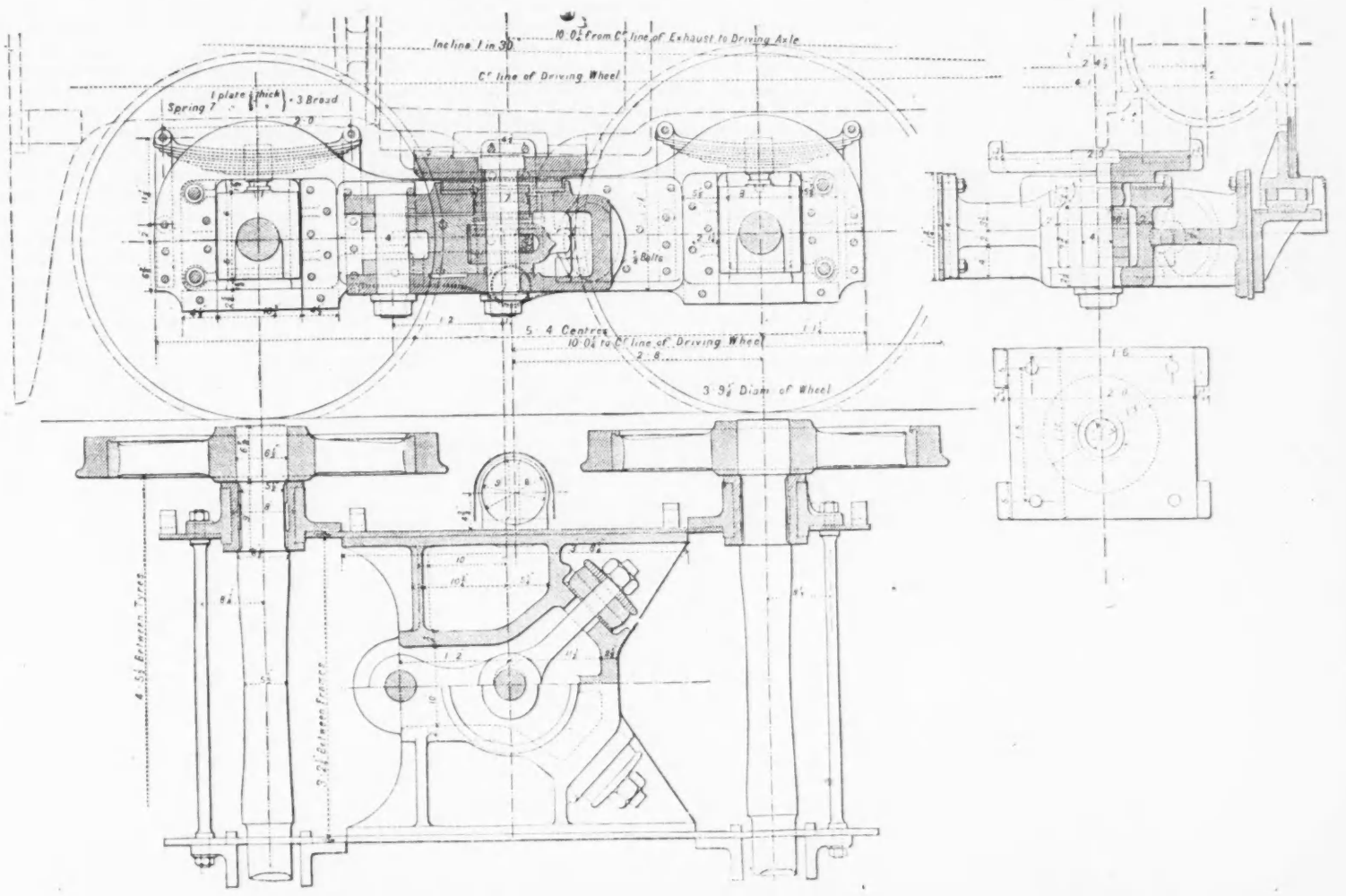

Incline 1 in 30
10' 0½" from Cr line of Exhaust to Driving Axle
Cr line of Driving Wheel
Spring 7 plate ⅜ thick 3 Broad
2' 0"
⅞ Bolts
5' 4 Centres
10' 0¼" to Cr line of Driving Wheel
2' 8"
3' 9½" Diam of Wheel
4' 5½" Between Tyres
3' 2½" Between Frames

Fig. 2.—Express Locomotive, Southeastern Railway (England).—Cross Section and Plan of Truck.

ient. It may be noticed that while the cast-iron centre projects into the truck beyond the point of rest, the truck is really driven by the leading pin, through the links, either backward or forward, the object of the projection into the main centre being simply to secure a stand-by to keep the truck on the road in the event of a pin breaking.

The steam reversing gear, Fig. 3, is very simple. It is arranged vertically on the side of the engine, and consists of a steam cylinder and a water cylinder or cataract. Mr. STIRLING invented this gear and introduced it on the Glasgow & Southwestern Ry. during the time he was Locomotive Superintendent of that line, sixteen years ago. It has given great satisfaction to drivers, and excited a great deal of interest among Continental engineers during the time the Paris Exhibition was open. It appears to be one of the best steam reversing gears yet used. It takes up no room on the foot plate, and can be used quickly or slowly at pleasure.

It will be seen that the engine is without a dome, but no trouble is incurred from priming. The reason is, that the internal steam pipe lies as close as possible to the top of the boiler, and is pierced with 260 holes, as shown in Fig. 1. The result is that the steam is drawn off equally throughout, and the water does not tend to lift in the boiler.

The Engineer says: "Many of our readers will, no doubt, be interested to learn that this engine remains in France; it is in regular work on one of the leading main lines, being tested against the French locomotives discharging the same duties. It must not be forgotten that French track is not so good as British roads, and it is possible that the springs may be found too stiff. If this difficulty does not arise, there is nothing else to prevent the engine from proving to our French professional brethren that English locomotive superintendents can teach them something."

The following list of dimensions and particulars is taken from *The Engineer*, Dec. 13, 1889:

	ft.	in.
Boiler (Siemens-Martin steel)—Length of barrel	10	4½
Diameter outside smallest ring	4	4
Thickness of plates	0	0 5/16
" tube plate	0	0 7/8
Fire-box casing—Length outside	5	9
Width outside at bottom	4	0
Thickness of plates	0	0 5/16
Height from rail to centre	7	5
Volume of water at 4 ins. above crown of fire-box	113·78	cu. ft.
Volume of steam at 4 ins. above crown of fire-box	54·32	cu. ft.
	ft.	in.
Copper Fire-box—Length inside box (parallel)	5	0⅝
Width at top	3	6½
" bottom	3	3⅞
Height from top of fire-bars to crown at tube plate	5	6½
Ditto at back	5	0½
Thickness of plates	0	0½
" tube plate	0	0¾
Distance between crown of fire-box and casing	1	7
Area of fire-grate	16·78	sq. ft.
Heating surface of fire-box	105·5	sq. ft.
Tubes—Length between tube plates	10 ft.	⅛ in.
Thickness	11 & 13	w. g.
Outside diameter	1⅝	in.
Number	202	
Heating surface	917	sq. ft.
Total heating surface	1020·5	sq. ft.
	ft.	in.
Smoke-box—Length outside	2	9¾
Width outside	5	1⅞
Diameter of door	3	8
Side plates, 5-16 in. thick. Front plate	0	0½
Chimney (cast iron)—Height from rail	13	4
Diameter inside (parallel)	1	4
Cylinders—Diameter	1	7
Stroke	2	2
Centre to centre	2	4½
Internal diameter of steam pipes	0	4½
Centre to centre of valve spindles	0	4
Length of steam ports	1	4
Width of steam ports	0	1½
Width of exhaust	0	3½
Slide Valves (phosphor bronze)—Travel in full gear	0	4 5/16
Lead in full gear	0	0 1/16
Outside lap	0	1
Truck.—Distance between frame plates (steel)	3	2¼
Thickness of plates	0	0¾
Diameter of wheels, with tires 3 ins. thick	3	9⅛
Centre to centre of axle bearings	3	7½
Length of bearings	0	9
Diameter "	0	5½
" at wheel seats	0	6½
" centre	0	5½
Length, centre to centre, of spring	2	0
Number of plates in ditto, 1 plate ½in. thick, and 7 plates ⅜in. thick by 3in. broad	8	plates
Camber loaded	0	1¾
Coupling Rods—Length, centre to centre	8	6
Length of pins	0	4
Diameter "	0	4
Connecting Rods—Length, centre to centre	5	11
Diameter of pin in crosshead	0	3
Length " "	0	2¾
Wheels—Diameter of coupled wheels, with tires 3 in. thick	7	0
Centre to centre of coupled wheels	8	6
Centre of truck to driving wheels	10	0¼
Crank Axle—Centre to centre of bearings	4	0
Length of bearings	0	8
Diameter "	0	7¾
" at centre	0	7
" seat	0	8¼
" of crank pin	0	7½
Length "	0	4
Trailing axle—Centre to centre of bearings	4	0
Length of bearings	0	8
Diameter of bearings	0	7¾
Diameter at wheel seat	0	8¼
Diameter at centre	0	7
Frame plates, (steel).—Distance between	4	1
Thickness	0	1
Bearing springs—Length, centre to centre	3	0
Number of plates, 1 plate ⅝in. thick, and 10 plates ½in. thick by 4ins. broad	11	plates.
Camber loaded	0	3½
Weight, in working order.	lbs.	
Truck	30,016	
Driving wheels	34,160	
Trailing wheels	28,784	
Total	92,960	

TENDER.

Capacity of tank	2,650	galls.
Coal space	about 4	tons.
	ft.	ins.
Wheels—Diameter, with tires 3 ins. thick	4	0
Distance, centre to centre	6	0
Axles—Centre to centre of bearings	6	4
Length of bearings	0	10
Diameter "	0	5
" at wheel seat	0	6½
" centre	0	5½
Frame plates (steel)—Distance between	6	7⅛
Thickness	0	0⅝
Bearing springs—Length, centre to centre	3	0
Number of plates, 1 plate ½ in thick, and 14 plates ⅜-in. thick by 4 ins. broad	15	plates.
Camber loaded	0	4¼
	lbs.	
Weight, in working order—Front wheels	23,072	
Middle wheels	22,512	
Rear "	22,736	
Total	68,320	

Notes on Buenos Ayres.

The following concise and valuable notes upon Buenos Ayres are the result, in part, of a late professional visit made to South America by Mr. WILLIAM F. SHUNK, C. E., and to his courtesy we are indebted for the privilege of presenting them to our readers:

Buenos Ayres is the capital of the Argentine Confederation. Its municipal boundaries include the whole Federal district, an area of 70 square miles, bordering on the southern shore of the Rio de la Plata. The sections or wards occupied at present by the city proper, and numbered 1 to 20, inclusive,

cover 17½ square miles, or about one-fourth the district area.

It is laid out generally in building blocks approximating 400 ft. square, the intervening streets being just 31 ft. wide between building lines. Sidewalks are prescribed to be not less than 4½ and not more than 5⅝ ft. in width, thus leaving a driveway of 20 to 23 ft. from curb to curb.

In the business quarter are many fine structures two and three stories high; but the impression of a one-storied town is left upon the mind of a stranger who rambles the place at large, so greatly, as in all Spanish-American cities, do the lower houses outnumber the loftier ones. The walls are of brick covered with stucco, cement or porcelain tiles; pale pinks, blues, greens and cream color the favorite tints. Iron I-beams are used almost exclusively for floor and roof frames, imported from England.

The population in 1887 was 404,000, not including the suburban towns, Flores and Belgrano, which counted 29,000. A collection of figures as to the growth of the city proper, exclusive of the suburbs above named, indicates that the population should be about 450,000 at present and in the year 1895, should be not less than 600,000.

Of the total, 433,000, including Flores and Belgrano, by the census of 1887, 53 per cent. were foreigners, the leading nationalities distributed about as follows: Italian 32 per cent., Spanish 9 per cent., French 4½ per cent., English 1 per cent., German 1 per cent., Austrian ½ per cent.

Immigration advanced at a quite regular rate from 1860 to 1880, being 134,000 between 1860 and 1870, and 265,000 between 1870 and 1880. Between 1880 and 1889 it rose to 576,500. A fair deduction from the statistics would fix the probable immigration, during the first half of the decade 1890-1900, at an average of 220,000 yearly.

The populous wards of the city are well paved with granite blocks; the suburban portions with wood, partly, for which granite is being substituted. Many outlying streets are unpaved; mud in winter, dust in summer.

Gas is the chief illuminant, at $4.30 per 1,000 cu ft., and $54.76 per street lamp per year. Kerosene in the suburbs costs $15 per lamp per year for street lighting, and is also much used for domestic lighting, at about $1 per gallon. The foregoing valuations refer to national currency, with gold at about $1.40.

Electricity is on the ground. The national government has employed it to some extent in parks and paseos. The municipal government has ordained that, in the event of its adoption by the city prior to May 1, 1895, the gas company shall have preference in establishing the system for public lighting at the lowest price offered by any other company. The leading North American electric companies have agencies and plants in Buenos Ayres. The consumption of gas is 15,000,000 cu. ft. per year, or thereabout.

The water supply has never been adequate to the need. The extraordinary growth of the city still left each successive improvement in deficit. Additions are now making which will increase the delivery to 17,000,000 galls. per day, or nearly 30 galls. each for 600,000 inhabitants. The water is drawn from about one mile off shore through a brick conduit, as in Chicago, pumped into filtering basins, and, after filtering, pumped into a distributing reservoir, or tank, at a central point in the city. It was ascertained by the census of 1887 that of 30,000 houses then existing only 4,000 depended wholly on public water; 4,000 on that and wells or cisterns, 5,000 on wells and cisterns exclusively, and no less than 15,000 on wells alone, 2,000 being without direct supply—all round numbers. It is not surprising that the public health gave evidence of the evil. The sewerage is being extended and perfected in connection with the improvement of the water-works, and in a few years Buenos Ayres will be fully modernized as to these essential provisions. Its private dwellings of the better sort probably have every modern convenience; not so the hotels. The proverb, "far sought and dear bought, is good for ladies," certainly fails of application to the hotel accommodations of Buenos Ayres, judged by home standards. The death rate at present is 22 in 1,000.

There are 110 miles of tramways so called, or street railroads, in the city, and probably an equal mileage chartered, but not yet built. A map of them indicates that all profitable routes, existing or prospective, are either occupied or pre-empted by franchise. In 1887 their passenger traffic amounted to 36,000,000 fares. Reckoning from the statistics of increase during previous years, they will probably have had a total of 50,000,000 fares in 1889. The series is well conducted.

Six steam railroads connect the city with the country. They are chiefly owned in England, and are equipped and operated in the English way.

The arrivals and departures of European steamships, taken together, average three per day. No American line visits the port. The writer could find but two vessels flying our flag out of 600 assembled there at the time of his residence, counting from two-masted schooners upward.

N. B.—The daily newspapers published telegraphic items from Europe via Galveston, gossip of the courts, society scandal, births of royal and princely babies, horse-race particulars and the like, but never a word from home during my whole stay, except Sullivan's fisticuff in Louisiana. The great republic pipes very small in those latitudes.

The annual imports at this time are valued at $150,000,000; exports, $110,000,000, distributed thus:

	Imports.	Exports.
England	35%	19%
France	20%	15%
Germany	10%	7½%
Belgium	8%	7%
United States	6 7-10%	4%
Italy	5%	2½%

From the Statistical Annual of the Province of Buenos Ayres for 1887, it is derivable that, during 172 successive days of the year, the average day light temperature, between 7 A. M. and 7 P. M., is somewhat less than 52° Fahr. The average temperature of the seven months, April-October, inclusive, is 54° Fahr., the minimum average being 46° Fahr. The thermometer touches freezing point occasionally, and there are flurries of snow and thin ice.

Latitude of the city 34° 36′ south; long., 58° 22′ west, of Greenwich.

So much for the present condition of the city and the expansion to be reasonably expected in the future. The remark may be added that the government is stable and public order well conserved. As yet it is a republic in the sense of Mississippi rather than Massachusetts; but the large influx of immigration, the working of the school system already inaugurated, and other potent influences will bring it to the Massachusetts standard before our cotton States shall have civilized to that degree. Meanwhile violent revolution will not be tolerated and need not be feared.

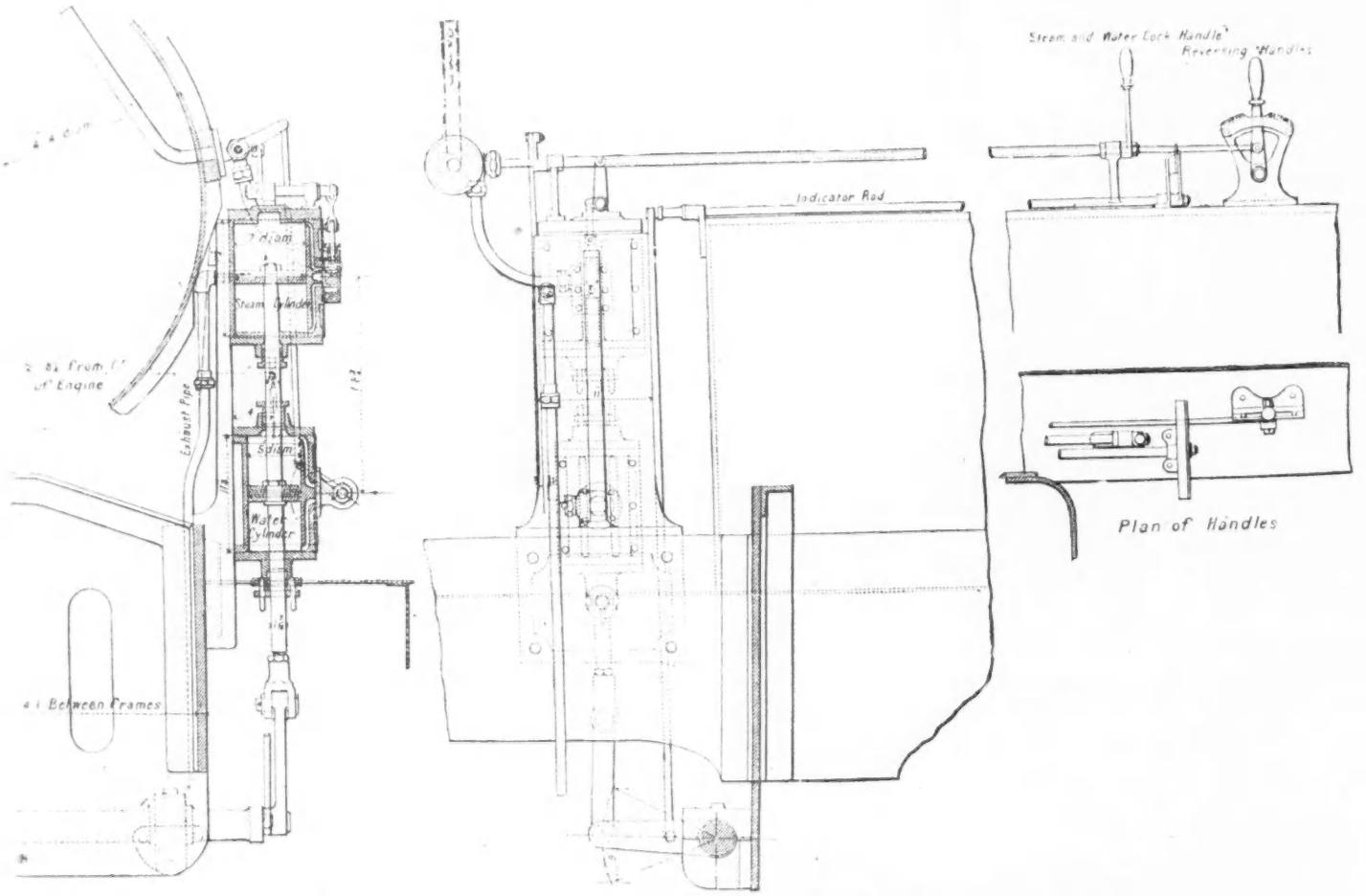


Fig. 3.—Express Locomotive; Southeastern Railway (England).—Steam Reversing Gear.

The Jull Snow Excavator in the Late Union Pacific Blockade.

We have received the following official statement of the work performed by the Jull centrifugal snow excavator in the recent unparalled blockade on the Union Pacific R. R., with reference to Mr. W. H. HOLCOMB, Vice-President, and Mr. G. W. CUSHING, Superintendent of Machinery of the Union Pacific Ry. Co., for the correctness of the statements made:

This excavator was sold to the Union Pacific Ry. on Nov. 26, 1889, for use on the Kansas division, and was housed at Ellis, Kan., there being no snow in that region until Jan. 11, 1890. This Jull excavator was ordered West on the failure of other plows to do the work, and encountered the first snow just west of Granger, Wyo., on Jan. 16. From Granger to Huntington, Ore., 541 miles, the snow was hard drifted in 4 to 5 ft. drifts at intervals. The excavator had no difficulty in making rapid progress through the snow with only two engines. As showing the immense power of the cone, it is stated that between Glens Ferry and Huntington a steer was caught in the cone while it was revolving at 75 revolutions per minute; the steer was cut in two and thrown out without the slighest impediment to the machinery.

From Huntington to Baker City heavy, hard drifts, averaging 6 ft. deep, were passed through steadily at a rate of about 8 miles per hour. Left Baker City on Jan. 18, and encountered numerous drifts 6 to 12 ft. deep, in lengths of one-quarter to one-half mile of hard, drifted snow; one other drift was 1½ miles long. Between Tallacassett and Union, about 6 miles, encountered the heaviest drifts, with snow 8 to 25 ft. deep, drifted, thawed, and then frozen, or "chinooked," as the Oregonians express it. The excavator went through all this with comparative ease, and cleared out a snow shed near Union packed 20 ft. deep with hard snow.

After opening up this division the Jull excavator was sent to open up the branch from Pendleton to Walla Walla, 42 miles, that had been under snow for three weeks. Another steam plow ordered there previously had failed to do the work. Between 11 P. M. and 7 A. M. of the following morning the Jull opened this 42 miles of road, with 10 miles of drift, averaging 7 ft. deep that had been frozen, and drifted for 21 days.

These facts were obtained from eye witnesses, and in a visit made to the scene immediately after the blockade was raised by Mr. G. H. HOBART, President of the Jull Manufacturing Co.

MR. HOBART calls particular attention to the fact that this particular excavator was built for use on some Eastern road without expectation of so severe a test. The excavator was operated solely by the employés of the Union Pacific Railway Co., without previous experience or any aid from the makers of the excavator. No repairs beyond tightening nuts and changing brasses were made during its trip. It worked night and day, and when its task was complete it was a perfect piece of machinery ready for further work. At no time were more than two engines used to propel the excavator in the heaviest snow; though three to four engines were used with other steam plows.

A New Freezing Process for Tunneling.

A late patent has been issued to Messrs. CHARLES SOOYSMITH and EDWARD L. ABBOTT, of New York, for a new application of the freezing process for tunneling in wet ground. Both of these gentlemen are members of Sooysmith & Co., the owners of the American patents on the Poetsch process for shaft-sinking by freezing.

The present device proposes to keep the advance heading of a tunnel in the form of a cone, and to keep the inner surface of this cone frozen to such a depth as to permit the excavation to be continuously carried on in frozen ground. For this purpose a freezing pipe or chamber is placed at the apex of the cone and advanced as the work progresses. This chamber is connected by proper piping with the refrigerating machinery; and if cold air alone is used this is allowed to escape in the cone, and thus to keep the wall of the cone frozen; this air is confined there by bulkheads provided with pipes for carrying off the air after it has done its work. The device has not been put into practice yet to our knowledge, and presents some difficulties that further experiment may overcome; the chief of these will be in preserving a sufficient thickness of frozen material around the cone, and preventing careless workmen from breaking through this crust.

Elements of Weather in the United States, of Most Interest to Engineers, for the Month of January, 1890.

STATION.	Temperature. (Deg. Fah.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Maxim.	Direction at time of max. velocity	Precipitation.—Rain and melted snow. Inches. Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.										
Northfield, Vt.	20.4	61	−10	71	11.2	54	W	2.76	0.57	19
Portland, Me.	23.2	62	−3	65	8.0	36	NW	2.89	.99	15
New York City	40.2	67	15	52	12.4	55	NW	2.59	1.50	12
Pittsburg, Pa.	41.4	71	11	60	6.4	35	NW	4.18	1.16	18
Chicago, Ill.	30.8	62	−5	67	10.7	42	NW	2.98	.94	14
Omaha, Neb.	18.2	52	−14	66	8.3	32	NW	1.44	.76	11
St. Paul, Minn.	9.9	42	−22	64	5.3	26	NW	.95	.30	9
Duluth, Minn.	12.2	44	−19	63	7.4	31	SW	.87	.30	14
Bismarck, N. Dak.	−2.1	39	−35	74	7.0	36	W	.80	.59	4
Average	21.6	75.6	−9.1	64.7	8.5	38.6		2.16	0.82	12.8
SOUTHERN CITIES.										
Washington City	40.0	76	19	57	6.0	40	NW	1.54	.38	12
Louisville, Ky.	44.8	72	14	58	8.0	36	SW	5.73	2.05	20
St. Louis, Mo.	39.2	74	8	66	12.0	56	SW	7.47	3.57	14
Savannah, Ga.	59.7	78	32	46	7.1	32	NE	0.44	.18	10
Leavenworth, Kan.	28.7	67	−6	73	4.5	30	SW	1.27	.40	10
Jacksonville, Fla.	63.4	80	40	40	5.6	29	NE	.63	.30	9
Chattanooga, Tenn.	50.5	75	25	50	6.8	35	SW	4.68	1.56	12
New Orleans, La.	65.1	82	36	46	9.4	36	SE	.66	.23	7
Memphis, Tenn.	50.8	79	23	56	9.0	36	W	8.43	2.78	16
Palestine, Tex.	55.5	79	22	57	6.8	82	NW	5.76	2.24	14
Average	50.2	76.2	21.3	54.9	7.5	36.2		3.66	1.37	12.4
WESTERN CITIES.										
Helena, Mont.	7.2	49	−23	72	3.0	30	W	.61	.32	9
Port Angeles, Wash.	31.4	46	9	37	2.8	30	NE	7.05	1.12	20
San Francisco, Cal.	51.1	59	36	23	8.0	30	NW	9.61	2.08	23
Salt Lake City, Utah	24.7	50	−2	52	5.5	32	S	3.07	.57	13
Denver, Col.	28.0	72	−8	80	6.8	48	NW	.18	.08	4
Yuma, Ariz.	51.0	80	30	50	5.3	28	N	Trace	Trace	0
Santa Fé, N. Mex.	32.1	58	2	56	6.8	30	N	.42	.20	8
Average	32.2	59.1	6.3	52.8	5.5	32.6		2.99	0.91	11

The Proposed New Panama Canal.

M. SAUTEREAU, one of the active engineers in the construction of the Suez Canal, proposes to finish the Panama Canal on a new basis. His scheme is to make a lake in the interior of the Isthmus by storing water from the Chragres River. This lake would be 15 miles long and cover about 800 acres, flood out the unhealthy swamps, and "make valuable" the 200,000 acres of land owned by the Panama company. It would have strong locks at both ends. The scheme is spoken of with favor in France, but no details have yet appeared.

PERSONALS.

Mr. JOHN C. CALHOUN has been elected Vice-President of the Georgia Central R. R.

MR. MATTHEW PATTON has been appointed Assistant Commissioner of Highways at Philadelphia, Pa.

Capt. JAMES M. PHILLIPS has been appointed Superintendent of Transportation on the Georgia Central lines.

MR. JOHN B. WINSLOW, for many years Superintendent of the Boston & Lowell R. R., died recently in Boston.

MR. W. T. S. SANGER, C. E., of Washington, D. C., and formerly an officer in the U. S. Navy, died on Feb. 17, aged 79 years.

MR. JOHN C. PATTERSON has been appointed Superintendent of the Butte & Gallatin branch of the Northern Pacific R. R.

Mr. WILLIAM R. CAVANAUGH, well known in Boston as a contractor for moving and raising buildings, died on Feb. 15, aged 56 years.

Mr. CHARLES M. HEALD has been appointed General Manager of the Chicago & West Michigan Ry and Detroit, Lansing & Northern R. R., vice Mr. J. B. MULLIKEN, resigned.

Mr. H. K. DIXON, who recently retired from the position of Auditor of the Cleveland & Canton Ry., has taken a similar position on the Fort Worth & Rio Grande Ry., with headquarters at Fort Worth, Tex.

MR. J. E. ROSE has been appointed Superintendent of the Baltimore & Ohio Southwestern R. R., with headquarters at Chillicothe, O. The position of Master of Transportation, which he has been filling, has been abolished.

MR. S. FORTIER, formerly with the Denver Water Co., and late First Assistant of the Citizens' Water Co., of Denver, Col., has resigned in order to accept the position of Chief Engineer and Superintendent of the Ogden Water Works.

MR. A. J. MCEVOY, ex-Superintendent of the Covington & Macon R. R., has been appointed Superintendent of the Middle Georgia & Atlantic road, which is being built by Mr. E. C. MACHEN. Superintendent MCEVOY will have temporary headquarters at Macon.

Mr. ROBERT T. DEVRIES, for five years Superintendent of the Columbus and Newark and Ohio divisions of the Baltimore & Ohio R. R., has resigned. He will be succeeded by Mr. GEORGE T. JARVIS, who has been Division Superintendent on the Michigan Central R. R.

MR. DAVID RUSSELL has been made Superintendent and Mr. H. TANDY Assistant Superintendent of the Brooks Locomotive Works at Dunkirk, N. Y. Mr. RUSSELL was formerly Assistant Superintendent and Mr. TANDY has been with the New York, Ontario & Western Ry., and was formerly with the Brooks Locomotive Works.

NORMAN SMITH, a lad of 8½ years, saved a West Shore passenger train from possible wreck near Kingston, N. Y., on Feb. 15. The train was approaching a deep rock cut leading to the high Rondout bridge, when the engineer noticed the little fellow standing in the middle of the track frantically waving a red bandana handkerchief. The air-brakes were applied, and the train stopped to find that a large quantity of rock and dirt had slipped down on the south-bound track. The grateful passengers made up a purse of money for the quick-witted boy, and the correspondent of the New York *Herald* says that the biggest millionaire in America isn't half so wealthy as Norman Smith thinks himself. He says that when he grows up he is going to be a railroad man, and that the position of superintendent would suit him.

WILLIAM JARVIS MCALPINE, Hon. Mem. Am. Soc. C. E., and one of the oldest and best known of American civil engineers, died at his home in New Brighton, Staten Island, on Sunday, Feb. 16. Mr. MCALPINE was born in New York in 1812, and was educated at the common schools of that city. His first engineering work was done about 1830 on the Erie Canal and the constructi

feeders and storage reservoirs for the same, and until 1846 he was the chief engineer of the Eastern division of the Erie Canal. At this time he commenced what was undoubtedly one of his greatest works as a civil engineer, the construction of the dry docks at the Navy Yard in Brooklyn. This work was brought to a successful end under Mr. MCALPINE, as chief engineer, in the face of unusual difficulties in the foundations, etc. In 1852 he was elected State Engineer of New York, and two years later he was made State Railroad Commissioner. Mr. MCALPINE was also at one time chief engineer and acting president of the Erie Railroad. He practiced as a consulting engineer of wide reputation for many years, and chief among his works in this direction were the Chicago and Toronto water works and the proposed introduction of water to New York from the Ramapo, in New Jersey; the Arcade railway project for New York; the Tehuantepec Ship Canal, the Brooklyn water works, the new Washington Bridge over the Harlem River, etc.

By invitation of the Austrian government, Mr. MCALPINE was one of a commission to report upon and suggest plans for river rectifications at Iron Gate on the Danube, and until within a few years he was practically consulting engineer for an English railway project for connecting the Bosphorous with the Indian railway system by way of Teheran. As the oldest American member of the Institution of Civil Engineers of London, having been elected to that body on March 5, 1867, his name as an engineer was well known in England, and his professional advice was frequently sought for in that country.

As engineer of the city bridge across the Harlem River in New York, he was one of the first of American engineers to apply the use of compressed air in sinking tubular foundations. For three years he was superintendent of the new capitol buildings at Albany, and laid the foundations for that structure. Mr. MCALPINE was one of the founders of the American Society of Civil Engineers in 1852, and from Aug. 5, 1868, to Nov. 3, 1869, he was the president of that society. He has submitted a number of professional papers to both the American and to the English societies, and for one of these, to the Institution of Civil Engineers, he received the Telford medal.

PUBLICATIONS RECEIVED.

—*Annual Report of the Chief Engineer*, Board of Public Affairs, Cincinnati, O. Report for 1889; 56 pp., with tables and a map showing the sewerage system.

Annual Report of the Superintendent of Lamps, Boston, Mass.—Pamphlet, 14 pp, with tables. This report for 1889 contains particulars of the gas, naphtha and electric lights, cost of operation, etc.

—*Interstate Commerce Commission Proceedings.*—Discrimination in rates between corn and corn products not justifiable on ground of water competition. The conclusion in this case was that rates on corn products should be made the same as on corn between Indianapolis and eastern points, and an order to that effect was issued.

—*Annual Report of the Chief of the Bureau of Steam Engineering for* 1889. Washington, D. C. Government Printing Office.

This report of the Chief of Bureau, Mr. GEORGE W. MELVILLE, U. S. N., contains much compact information in the shape of 41 photo-lithographs of engine and machinery plans for our new war-ships; many of these plates have all dimensions given. The plans relate to the battle-ships *Maine* and *Texas*, reconstructed double-turreted monitors, the Thomas cruising monitor, armored coast defence vessels, steam cutters and steam whale boats. The text is condensed but presents, mainly in tabular form, much information regarding the condition of our steam navy, yards, etc.

TRADE PUBLICATIONS.

Pumping Machinery.—Illustrated catalogue of the Deane Steam Pump Co., Holyoke, Mass. Pamphlet, 90 pp.

Carts, Wagons, etc.—Folding sheet of illustrations of street sweepers and sprinklers, patrol wagons, stages, etc. Abbot-Downing Co., Concord, N. H.

Water Purification by the Hyatt System.—Illustrated pamphlet, 54 pp., with description and testimonials of the Hyatt filter. Hyatt Pure Water Co., New York.

Fernoline.—Pamphlet of the Fernoline Chemical Co., New York, 12 pp.

The fernoline is used as a paint and as a bath for preserving ties and timber. A cut of two pieces of timber which were fastened under water, shows the untreated piece covered with barnacles and worms, while the treated piece is clean. Several testimonials are given.

The Thomson-Houston Electric Motor.—Pamphlet, 55 pp. Thomson-Houston Motor Co., Boston, Mass.

This pamphlet contains particulars of the use of these motors for mill and mine tramways, hoists, machinery, drawbridges, etc. There are a number of cuts, most of them reduced from photographs.

Worthington Pumping Engines.—General illustrated catalogue of Worthington pumping engines, steam pumps, and hydraulic machinery. Size 7½×9¾ ins., 88 pp. Henry R. Worthington, New York, Jan. 1, 1890.

This new edition of the catalogue contains illustrations, descriptions, and tables of dimensions of various patterns of pumps, condensers, pressure regulators, water motors, etc. There are also sectional drawings of pumps.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—At the meeting on Feb. 19, Mr. Hamilton in the chair, the Secretary announced the death of Mr. Wm. J. McAlpine, Member and Honorary Member of the Society. He referred to the valuable library of engineering works which Mr. Mc Alpine a few years ago presented to the Society.

Mr. Frank Velschow, C. E., read a paper on "The Causes of Rain." He referred incidentally to the wide variations in barometer readings taken at the same point with the atmosphere at different degrees of humidity. Mr. Chas. E. Emery stated that pocket barometers had a considerable "position error." While they would register correctly if used regularly in a horizontal or vertical position, they would be subject to considerable variations if used indiscriminately in either position.

New England Water-Works Association.—At the meeting on Feb. 12, at Boston, Superintendent Dexter Brackett, of Boston, presided. Mr. F. F. Forbes, of the Brookline water-works, talked on the purity of the water and the growth of plants in the reservoirs of Brookline, Newton and Boston. From experience he was led to believe that it was doubtful if water was improved by circulation, except in ponds. An experiment at the Brookline reservoir of pumping in water to circulate through that already in the reservoir, with a view to improving the quality, had proved this fact. Prof. Drown, of the Institute of Technology, related his observance of minute plants in reservoirs, and coincided with Mr. Forbes in a belief that if light is excluded there is no food for plants and smaller animals, and consequently these things disappear.

Engineers' Club of Kansas City.—At the regular meeting on Feb. 3, Mr. Thos. Knight read a paper on "Some Geological Field Work in Southern Missouri," being a general *resumé* of investigation undertaken to determine the following points:

1. The mineral resources of the country, having special regard to the prospects for coal, iron, lead, zinc, copper and tin.

2. Its general economic productions with a view to a systematic and extended immigration.

3. The sufficiency, or otherwise, of the existing railroad system, and to what extent capital might be employed in extension.

The information demanded by the instructions thus itemized being such as to give prominence to the geological aspect of the question, it was from this standpoint that the subject was considered. The mineral resources of the State, together with the extent of coal field, were pointed out; and some examples given of metamorphosis and the deposition of metallic ores.

Incidentally the opening up of a rich mining district tributary to Kansas City was alluded to, and an enumeration made of the economic productions of the State.

KENNETH ALLEN, *Secretary.*

Liverpool Engineering Society.—The eighth ordinary meeting of the present session was held on Jan. 29. Mr. Henry H. West, M. Inst. C. E., President, in the chair. After the usual business, Mr. Chas. H. Yeaman, A. Inst. C. E., etc., read a paper entitled "Notes on Central Station Electric Lighting." In giving an account of several stations at present supplying current on a commercial basis, he described the West Brompton high tension, Glasgow high tension, Hastings, Eastbourne and Brighton stations; Crompton's battery system used at Kensington Court, and King's subdivided battery system in use at Chelsea, and illustrated his descriptions by mounted prints and diagrams. The history of the stations was traced, and the changes in the various systems employed noted.

The author then compared and discussed the methods adopted to generate, measure and distribute the electric energy with regard to their general advantages, and drew conclusions therefrom as to the system of supply which will probably become general. Complete sets of junction and distributing boxes and samples of the mains employed and in use at Liverpool were shown. Samples of Fowler's cables, as used by the House-to-House Company at London and at Eastbourne were also exhibited.

In concluding, the author gave a short account of what is required of an electric supply company under law and by the public demand, with special reference to the Board of Trade rules and to the curves of supply obtained from the various stations alluded to. The discussion upon the paper was adjourned till Feb. 26.

National Electric Light Association.—The annual convention was held at Kansas City, Mo., Feb. 11, 12, 13 and 14. At the meeting, on Feb. 11, business was transacted. On Feb. 12, the report of the committee on abolition of the duty on copper was presented by Mr. Phelps, who requested that all members who have not yet signed the petition for the withdrawal of said duty communicate with either Mr. C. A. BROWN, of the Western Electric Co., Chicago; Mr. J. F. MORRISON, 15 South St., Baltimore, Md.; or himself at 150 Broadway, New York City. The committee recommended that a memorial be presented to Congress, with a view of accomplishing the object of the committee. The secretary read a report from the Committee on Underground Conduits and Conductors, stating that the work of this committee had been delayed by the difficulty in securing a quorum. The committee was discharged, and a new committee appointed. The Committee on Standardizing Potentials on Electric Street Railways presented an interesting report, which contained much valuable information. Mr. P. H. Alexander presented the report of the committee on harmonizing insurance and electrical interests, and recommended the appointment of special instructors for the benefit of fire insurance underwriters. C. J. H. Woodbury's paper on "Central Station Construction," and F. E. Sickel's paper on "The History and Theory of the Steam Engine," were read.

On Feb. 13 the following papers were read: "The Economic Generation of Steam," Geo. H. Babcock; "A Recent Edison Central Station and the Results Thus Far Obtained," C. J. Field; "A Universal System of Central Station Accounts," T. Carpenter Smith; "The Cost of the Products of Central Stations," A. J. De Camp; "Nine Years with the Arc Lamp," Mr. D. Law; "Tests of Arc Light Carbons," E. F. Peck; "Safety and Safety Devices in Electrical Installations," Prof. Elihu Thomson.

On Feb. 14 the following papers were read: "Electric Street Railways," F. J. Sprague; "Line Insulation," C. A. Harber; "Locating Grounds on Arc Light Circuits," J. E. Lockwood. A committee was appointed to devise plans to discourage the reckless and disastrous competition by which it is claimed that the stocks and bonds of many electric light companies are being depreciated in value by rival parent companies.

The following officers were elected: President, M. J. Perry, of Providence, R. I.; First Vice-President, E. A. Maher, Albany, N. Y.; Second Vice-President, C. L. Edgar, Boston; Executive Committee, C. R. Huntly, Buffalo, N. Y., Chairman; E. R. Weeks, Kansas City; James E. English, New Haven, Conn.; J. J. Burleigh, Camden, N. J.; M. D. Law, Philadelphia; M. J. Francisco, Rutland, Vt.; A. F. Mason, Boston; J. A. Seely, New York; H. K. Thurber, New York.

New England Railroad Club.—At the meeting on Feb. 12, the subject for discussion was "The Master Car Builders' Standard Form of Contract for Chilled Wheels." It was opened by Mr. J. N. Lauder, whose remarks we condense as follows: This subject was agitated two or three years ago by the wheelmakers and the railroad associations. Action was taken at that time, but there never has been to my knowledge any organized effort to put into effect any of the principles discussed and agreed upon at that time as a good system of contract for car wheels. The reputable wheelmakers several years ago formed an association to devise ways and means, as I understand, to protect themselves in some degree against what might be called illegitimate wheel manufacture. It is a well-known fact that a first-class wheel made by a reputable manufacturer costs about $10, and cannot be procured for much less if proper material and workmanship is put into it. We also know that wheels have been sold to some railroads at prices very much below that. The problem is how to protect the railroads and the honest manufacturers of wheels against these cheap productions. You may tie the car-builder up as tight as you please with specifications, but unless you actually specify the make of the wheel, it will do very little good; even then the builder may manage to buy his wheels in some way at such a price that possibly they are not quite up to the standard even if made by reputable wheel makers, though I think most makers make but one quality of car wheel.

The Manufacturers' Association, in order to have a full understanding of the matter and to get the experience and judgment of the railroad men, called upon the Master Mechanics' Association and the Master Car Builders' Association to appoint committees to meet with the wheel manufacturers, to see if they could formulate some plan by which both parties could be protected against these cheap wheels. Each of the two associations appointed a committee of three to meet with a committee of six of the manufacturers of wheels, making a full committee of twelve. They held two meetings in Chicago and one in Buffalo, and finally formulated a system of specifications and tests of wheels and a form of contract that we believed would be just to the wheel makers and the railroads, and at the same time furnish an incentive to the makers to produce a better wheel. The result of their proceedings was reported to the three organizations referred to for their consideration.

[See ENG. NEWS, Vol. XXII. Page 90, for form of contract decided on by the committee.]

This report was submitted in June, 1888, to the Master Mechanics' Association, which adopted it by unanimous vote. The Master Car Builders' Association laid it on the

table for one year. At their meeting in June, 1889, the matter was taken up and thoroughly discussed, and after some minor changes it was voted to put it to letter ballot by the railroads. The ballot was taken, and it was adopted, showing that the railroads recognized the justice and wisdom of the work done by these three committees as a joint committee. Unless this system of contract for wheels had some merit in it, and was thought to be a fair and just way of settling for the wheels, it never would have received the majority of the votes of the railroads of the country. Why since then there has not been any effort to push this matter by the wheel-makers, I cannot say. Its adoption by letter ballot makes it one of the standards adopted by the Master Car Builders' Association. A standard adopted by that association is not binding on any railroad, but it has a moral binding force which ought to be regarded. The purchasing agents who buy for the roads would do well to consider this matter carefully.

I am aware that perhaps the railroads would not figure out any saving in dollars and cents by purchasing their wheels under this system. On the Old Colony road we buy wheels for so much apiece, for service guaranteed; and if a wheel does not make its guaranteed mileage, if it is not rendered unable to do so by defects not caused by the wheel maker, he is bound to give us a new wheel by his contract, taking the old one away, he getting nothing for what mileage that wheel has made. This seems unfair on the face of it, but I suppose the wheel makers stand it, because practically there is no guarantee for wheels put under freight cars, and they make up their loss in that way.

I think the railroads would receive benefit by making contracts under this system which I have presented, and they would get better wheels; the system would give the wheel makers an incentive to make the best wheel they could, even if the price they got for the wheel was very near the cost price. If they make a wheel that exceeds the guaranteed mileage, they get paid above that mileage according to the excess; so they have an inducement to construct a wheel that will make a large mileage. The objection may be made that it is an easy matter to get a wheel that will give a large mileage, but such a wheel may be very unsafe to run. That is met by the system of tests which are intended to go with this form of contract If the wheels do not stand a certain test they are thrown out. This system would bar out cheap wheels, and that is what the railroads want, because there is danger in cheap wheels.

As to methods of settlement, I think this system provides the simplest possible way of settling with the wheel maker. For instance, you contract for a wheel for $10, and the maker guarantees 50,000 miles; now if the wheel has made 60,000 miles when it is scrapped, you simply credit to the maker the extra 10,000 miles; if it has made 45,000 miles you charge him with 5,000 miles; if it has made but 30,000, you charge him with 20,000; if the wheel has travelled 100,000 miles, you credit him with 50,000 beyond the $10 he gets for that wheel. A large mileage is profitable to the railroad, because it saves detention of cars in changing wheels; it costs, perhaps, $3 to shift a pair of wheels. Many things come into the account which do not appear in dollars and cents. I believe this is a fair and equitable way of settling, and I believe it would have a tendency to improve the quality and character of our wheels over those we have at present, when there is really no system.

Mr. LAUDER then read the following paper by Mr. W. W. Snow, of the Ramapo Wheel & Foundry Co.:

The changes in the specifications from those that were submitted by the Conference Committee have been so slight that we will make no reference to them at this time. The changes made in the guarantee have been in some respects liberal, and the remarks of the committee as stated in the second paragraph, referring to the special purposes of this guarantee, are very satisfactory. We are certain all wheel makers will appreciate the co-operation of railroad officials in assisting to raise the standard of chilled iron wheels.

We, however, regard the omission of wheels removed because of sharp flanges from the list of those for which the maker is *not* responsible as very severe, and we think there is apt to be much controversy on this point. A very large proportion of sharp flanges is due to other causes than the quality of the chill on the wheel. At a recent meeting of the Wheel Manufacturers' Association the Master Car Builders' report was under consideration, and it was recommended by that association that where wheels are removed for sharp flanges the flange should be broken, and if the fracture shows a good bright chill it shall be evidence that the flange wear was produced by other causes than those for which the wheel maker is responsible.

Referring to the proposed settlement, we would suggest that the form or table given on Page 86 of the Master Car Builders' Annual Report is somewhat misleading. This table represents the comparative value of, or difference between the high and low-priced wheels. It is not a table by which settlements can be made, as it places no value on the old wheel. To place the matter in its proper light we would suggest a careful consideration of the relation of the scrap value of a wheel to the price of a new wheel. We find there are two items of value in a wheel. One is the scrap value, which must always be recognized in the new wheel as well as in the old; this value is always about 45 per cent. of the cost of the new wheel. The other item of value is the service of the wheel in miles or months.

To illustrate a settlement on this basis:

Cost of wheel	$10.00
Scrap value, 45 per cent	4.50
Service value	5.50

This service value, $5.50, is guaranteed to equal 60,000 miles in service performed. We, therefore, find the cost to the user to be 1-60 of $5.50, or 9 1-6 cents per 1,000 miles of service

It is quite evident that this 9 1-6 cents per 1,000 miles of service should be the basis of settlement for a wheel costing $10, and the table, as presented in the report, should be adjusted to the facts as already shown.

The following table represents the scrap and service values, together with the proper contract rates for the settlement of mileage of wheels costing $11, $10, $9 and $8, respectively:

Cost of wheel	$11.00	$10.00	$9.00	$8.00
Scrap value, 45 per cent	4.95	4.50	4.05	3.60
Service value, 55 per cent	6.05	5.50	4.95	4.40
Basis of settlement for short mileage under guarantee of 60,000 miles, given in cents per 1,000 miles	10 1-12	9 1-6	8¼	8⅛

The above table corresponds with the method of computing the cost of wheel service, as suggested by the Wheel Makers' Association hereto attached, and submitted for consideration.

METHOD OF COMPUTING COST OF WHEEL SERVICE AS SUGGESTED BY THE WHEEL MAKERS' ASSOCIATION.

In adjusting the price at which a scrap wheel should be charged back to the maker, either for the purpose of charging the short mileage or crediting the excess over the guarantee, it is understood that 45 per cent. of the price at which the wheel is sold would represent its value as old material, and 55 per cent. would represent the actual cost to the railroad company.

Suppose, for illustration, that a 33-in. passenger car wheel, weighing from 550 to 560 lbs., and guaranteed for 60,000 miles service, is sold for $11. When that wheel is scrapped, 55 per cent. of its first cost, or $6.05, is charged back to the maker. As an offset to this charge the maker receives a credit for the service that the wheel has performed. On the foregoing basis of price the rate of credit is ascertained by dividing $6.05, the actual cost of the wheel, to the railroad company, by 60,000, the guaranteed mileage—making 10,083 cents per 1,000 miles of service. At this rate, if the wheel made but 50,000 miles, the maker's credit would be 50 times 10,083 cents, or $5.04. As the wheel cost the railroad company $6.05, according to the terms of the contract, the maker would have to pay the difference between $6.05 and $5.04, the amount of service performed, or $1.01.

Any excess of mileage that the railroad company had to pay the wheel maker would be computed on the same basis.

Mr. MARDEN: I believe that the best wheel that a company can buy is the cheapest wheel for it to use, and if it actually costs $10 to make a good wheel I don't believe that a railroad company which buys one for $8 is going to get a good wheel. I think it is economy for railroads to encourage the making of first-class wheels and they ought to be willing to pay a fair price for such wheels. I have been told that roads have used wheels that cost them about $7 apiece, and they considered they could afford to use such wheels, could afford to have an accident once in a while rather than buy a better class of wheels. I don't believe in that policy. I believe that we had better pay $12 for a good wheel made by a reputable maker who will use nothing but the best of material, and who distributes that material in the best possible manner for the wheel.

As to the contract adopted by the Master Car Builders' Association, I agree with Mr. Lauder that it provides a fair and equitable way of settling between the wheel makers and the railroad companies. The Fitchburg road adopted that method immediately on its passage, and we had used a similar method some time before it was adopted by that association. I can hardly agree with Mr. Lauder as to the standards adopted by the association. Since the reorganization of the Master Car Builders' Association and the appointment of representative members by the different roads, who are authorized to cast the votes of the roads they represent, I believe when such votes are cast, or when a letter ballot was taken, and a standard adopted, it really should be binding, and I believe it is binding on the roads to use that standard, as far as practicable, on the rolling stock they own. I hardly believe in admitting that a standard adopted by the Master Car Builders' Association ought not to be binding, because I think the nearer we keep to standards and the more standards we use the more economy there is in the working of the roads.

Mr. SHINN: I think that one point has not been brought out sufficiently, and that is the real cost of changing wheels. We have to consider not only the actual expense of making the change by the workmen, but also the cost of bringing a car with a bad wheel back to the shop, which may be a hundred miles distant, and the detention of the car, sometimes for days, and perhaps weeks, say at an expense of 50 cents per day to the railroad company. Now if the average expense of changing a wheel is $2.5 to any company, that $2.50 is a fixed charge, and canno be left out of the account.

Mr. MARDEN: I think the point that Mr. Shinn makes is a very good one. As he states, the expense of changing a wheel varies much with the conditions of each case. and at times the expense may be a very considerable item That only goes to show that it is economy for the roads to buy the best possible wheel they can, without regard to expense. If it is necessary to pay $14 or $15 for a good wheel that would run 100,000 miles we should be gainers in the end.

Mr. CURTIS: If we should charge to the wheel-maker the number of days that a car is lying idle waiting for the wheels to be changed, at the rate of 50 cents per day, he would soon want to go out of the business, and he now claims that his profit on a chilled wheel costing $10 is not over 75 cents. I think the mileage system of paying for wheels would be an advantage both to the railroads and the manufacturer; but if you bring in the cost of exchanging the wheels and things of that nature, you will not accomplish much. Unless you allow something in favor of the manufacturer he will not be benefited in any way.

Mr. MARDEN: The tendency on the part of railroads to buy everything as cheap as they can ought to be resisted. It is poor economy to try to get a wheel maker or an axle maker to produce an article for less than the cost of the material that enters into it. It is a vital point of safety in the car to have under it the very best wheels and axles that can be had.

Mr. LAUDER: I don't think we need trouble ourselves very much in regard to the matter of the cost of changing wheels; it is a thing that will regulate itself. A system of this sort to be of practical value should be as simple as possible. Under this system I believe the wheel makers would produce wheels that would make more than their guaranteed mileage; if they should make less the producer of the wheels would not make them very long. There would be no motive for a road to take a wheel out before it is worn out, if it simply paid for the mileage made by the wheel.

Mr. ADAMS: The system under discussion seems fair to both the roads and the wheel makers. It holds out an inducement to the wheel makers to produce a better wheel, because they will get more money for it by settling on that basis, and it certainly will be to the advantage of the railroads to have a better wheel, because it will save them expense in changing, which is a large item, directly and incidentally, especially where the cars are a long distance from the shop. It would be a benefit to the railroads if we could drive the cheap wheels out of the market, and their makers out of the business. The fact that steel wheels run so much longer than iron ones, and do not have to be changed so often, as well as being so much safer, is a strong argument in their favor. It is a very poor steel wheel that will not make 75,000 to 100,000 miles before it requires turning, and we have a good many in our cars that have gone 150,000 miles without turning, and a number that have gone over 200,000 without turning. When wheels make mileage like that there is not much expense in changing wheels, or for brasses. It is a matter of surprise to me that roads do not generally adopt steel wheels for passenger equipment; I cannot see how iron ones are cheaper, as some contend. I think it is doubtful if the system proposed for buying wheels will come into general use. My experience leads me to believe that the roads will buy their wheels of makers who give the best satisfaction and in whom they have the most confidence; and if they buy of a man whose wheels give a large percentage of breakage they will leave him and try somebody else. I am inclined to think that when a man buys a cheap thing he almost always gets cheated.

Mr. NYE (J. S. Heartt & Co.): If a wheel maker agrees to furnish a wheel 33 ins. in diameter, weighing 600 lbs., and guarantees it to run 50,000 miles, and it runs 49,000, he should have the pay for the mileage it has made, and you can sell your wheel for what it is worth; but the road says it wants a new wheel in place of the old one, which I think is very unjust; it ought to pay for the work that the wheel has done on the road. I believe that the mileage that a wheel does not make under the guarantee should be charged to the maker, and the mileage that it makes in excess of that guaranteed should be credited to him. Give us that chance. I will be glad to take it, and we will stand even every time. If you want a wheel for $10, you shall have it; if you want a $12 or $13 wheel you shall have that. I am willing to stand on a guarantee of 60,000 miles for my wheels, with a fair and honest mileage, if you will give me credit for what my wheel makes in excess, and charge me with what it does not make, and I will make more than if I sold them straight out for so many miles. You have them on several of your roads that have made 70,000, 80,000, 90,000 miles; and still you send into my shop wheels that have not made their 50,000 miles and ask for a new wheel in exchange. That is not a fair way of doing business. If you will treat the wheel makers as they treat the roads, the wheel makers would have a little dividend at the end of each year.

At the next meeting on March 12 the annual election of officers will take place. The subject for discussion will be "Freight Car Couplers."

ENGINEERING NEWS

AND

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D. McN. STAUFFER A. M. WELLINGTON

EDITORS.

CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER

ASSOCIATE EDITORS,

GEO. H. FROST . . . . . BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia, Pa.—Next meeting March 1. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Next meeting, March 3. "Photography Applied to Surveying." G. W. Pearsons. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, March 3. Secy., Geo. L. Wilson, City Hall.

Western Society of Engineers, Chicago, Ill.—Next meeting, March 5. Secy., J. W. Weston, 230 La Salle St.

Engineers' Club of St. Louis, Mo.—Next meeting, March 5. Secy., W. H. Bryan, 46 Laclede Building.

American Society of Civil Engineers, New York.—Next meeting, March 5. Secy., John Bogart, 127 E. 23d St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, March 6. Secy., Clement March.

Civil Engineers' Club, Cleveland, O.—Next meeting, March 11. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, March 12. Secy., J. C. Herring, Wichita.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, March 13. Secy., Olin H. Landreth, Vanderbilt University.

Western Railway Club, Chicago, Ill.—Next meeting, March 18. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, March 18. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, March 18. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, March 20. Rooms at 113 Liberty St.

AT a meeting this week of the Society of Electrical Engineers, Mr. WILLIAM MAYER, Jr., electrician of the Consolidated and Electrical Subway Co., read a paper on "The Practical Working of Electrical Subways in New York." In the course of his paper Mr. MAYER estimated that a first-class subway, sufficiently large to contain all the electrical wires and its gas and water mains, would cost about $130,000 per mile. On this basis a subway up Broadway, from Bowling Green to Central Park, would cost $2,150,000, and if placed on the line of all existing electrical subways it would cost $30,000,000.

This is a large sum of money and we do not know just what dimensions Mr. MAYER has given to his subway. But is it after all too large a sum for the city of New York to pay for having its main thoroughfare kept unbroken and in a decent condition? It is to be supposed that were this comprehensive subway to be built at all, it would be made large enough to meet the demands of years to come, and so substantially constructed that it would require little or no repairs. Were this once done and arrangements completed for making all additions to systems, changes, repairs and connections in the subway, there should be no necessity for the breakage of street surface, now so frequent; and the city could well afford to put down a thoroughly first-class street pavement and maintain it in perfect condition. To pave Broadway once would cost at least one-fourth of the estimated cost of Mr. MAYER'S subway from the Bowling Green to Central Park, and this first cost of paving is by no means the only consideration. No matter how much money is expended under present conditions, we can never have either a good street or a clean street for any length of time. The best foundation possible will fail if it is to be frequently cut and trenches dug beneath it to permit after settlement. If we contrast with the present state of affairs a perfect pavement, easily cleaned, and the resulting comfort and profit to wheeled traffic of all kinds, the absence of annoyance to and serious interference with the business and health of the millions that annually use Broadway, it does look as if two million dollars might be spent with much less profit than in building the subway referred to. As we have before remarked, this amount, and probably much more, will be expended before we find a small type of subway that will meet the present requirements of efficiency, and have ripped up the failures. Every really good good thing costs money; and it is notoriously false economy to spend all your capital in trying to find cheap methods of performing what we should realize at the beginning is a task of enormous dimensions and necessarily great cost.

NEW ORLEANS and the Mississippi Valley want another outlet to the sea, another channel opened through the Delta of the great river. No stronger proof is needed of the value of the work already done there by Capt. EADS and his associates, in the face of vigorous opposition and dismal prophesies of failure, than the fact that the reason given for this later demand, is that the present outlet has so developed commerce that it is becoming inadequate to meet the demands upon it. Giving due credit to the chronic fondness of the owners of almost every American harbor and water-way for an appropriation, the present call for Government assistance at the mouth of the Mississippi is backed by a force of argument and experience that should command respect. But whether this second outlet be actually needed to better provide for present and prospective traffic, or simply as a precaution against the accidental blockade of a single channel, the success of the first channel in creating a demand for a supplementary one is most gratifying to the friends of the late Capt. EADS and to American engineers generally. It was a mighty work well carried through.

SINCE the publication of our last issue we have received from the McConway & Torley Co. a letter in which they say: "We have just received from the 'Erie' what seems to be a 'cleaning up' lot, consisting of 93 broken couplers and 126 broken knuckles. The inspection shows that 82 out of the 93 couplers had mechanical defects." For the sake of accuracy we note this correction, although its inclusion in the records would make hardly a perceptible change in the general percentages. Its effect on the Erie records may be easily seen by reference to the diagrams on page 153 of our last issue. It would bring the knuckle breakages of the Erie up well toward the average. Its change in the coupler diagram would be comparatively small, but it would tend to increase somewhat the excess which the Erie shows over the other roads. The explanation for this is found in the very large proportion of the breakages (91 per cent.) due to mechanical defects in the couplers. Thus while the above correction tends to confirm the accuracy of the record by bringing the abnormally small percentages of broken knuckles on the Erie up toward the general average, it also confirms our surmise of last week that the Erie's excess of coupler breakages was due to some especial defects in its couplers, which, however, results in no loss to the company, since the manufacturers replace such defective couplers free of charge.

APROPOS of the census of next June, there is an interesting estimate of the future population of "Our Colonies in North America" to be found in *The Lottery Magazine*, published in London in August, 1776, and now lying before us. The editor, in speaking of the comparative population of Great Britain and North America, figures out that in 1892 the "colonies aforesaid" would have a population of 64,000,000. While no exact figures exist, the estimated population of the belligerent American colonies was 2,200,000 in 1776, and the *Magazine* fixes the area capable of settlement at 1,122,800 square miles. Upon the somewhat crude basis of doubling the population once in twenty-five years, and without giving any reason for the rate, the editor makes up a schedule which when compared with the United States census returns for the nearest decade would stand as follows:

Lottery Magazine Estimate.		*U. S. Census Return.*	
1792	4,000,000	1790	3,929,214
1817	8,000,000	1820	9,633,822
1842	16,000,000	1840	17,069,453
1867	32,000,000	1870	38,558,371
1892	64,000,000	1890	63,000,000

The actual figures for 1890 can as yet only be estimated; but there can be little doubt that the figures given 114 years ago will be much nearer the truth than the average long-range guess.

As the population of the prospective United States in 1776 was very small, and little data existed for forming an estimate of the rate of growth, the rate assumed could have been little more than a guess; though, as the comparison shows, it was an unusually close guess for each of the periods given.

In closing his article, however, the editor of the *Magazine* expresses his belief in the existence of certain obstacles to the rate of increase assumed which he feared might materially interfere with the realization of his estimates. The chief of these obstacles, as he saw it, would be the constantly increasing distance from the seacoast of the center of population, and the lack of transportation facilities. Railroads, of course, did not enter into his scheme of growth; and it is very safe to say that without railroads his doubts as to the rate of growth would have been well founded. But as he knew nothing of the means by which this country was to be settled, his accidental guess at very near the actual figures is all the more remarkable.

THE LABOR involved in taking the census of 1890 in the United States can, to some faint degree, be estimated by the quantity of stationery required for this purpose by the census bureau. The government printing office has just been ordered to prepare 20,000,000 population schedule blanks, and 10,000,000 more will be ordered in a few days. In addition to these there will be 20,000,000 recorded indebtedness blanks, 8,000,000 manufacturers and 2,000,000 agricultural schedules. Of circulars 600 different kinds have already been printed aggregating 12,000,000 in number, and

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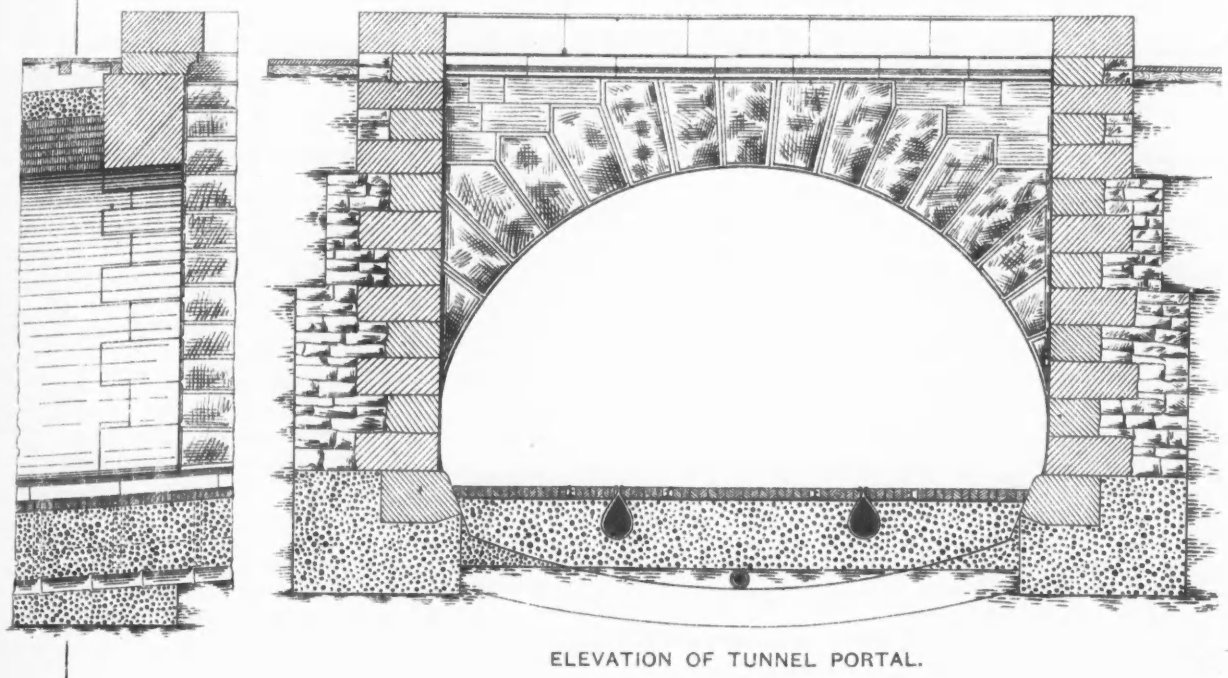

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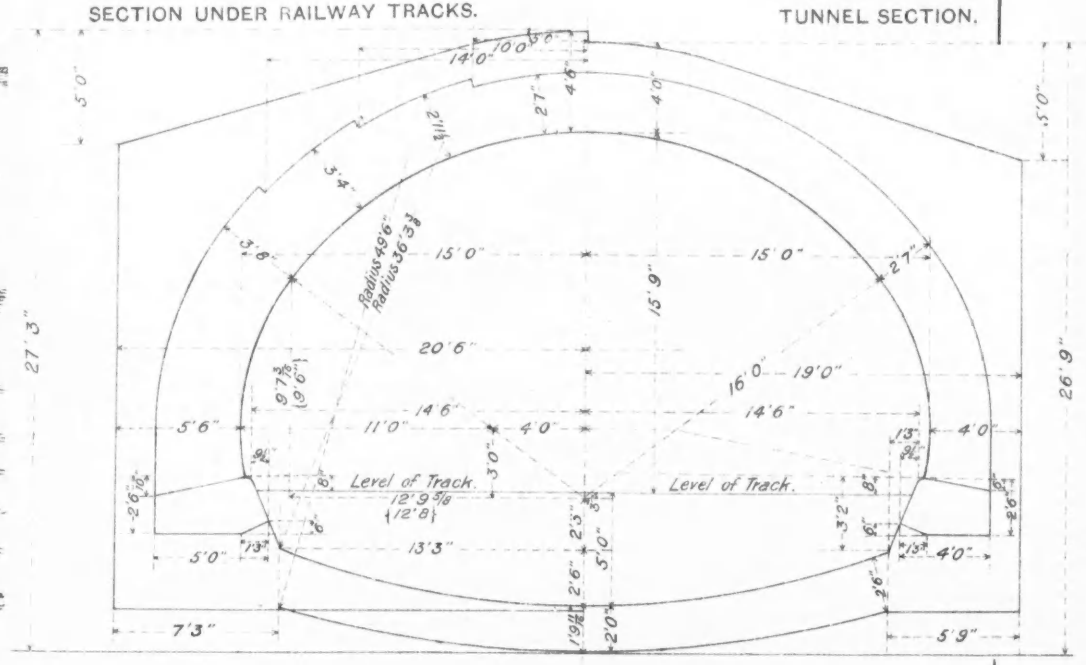

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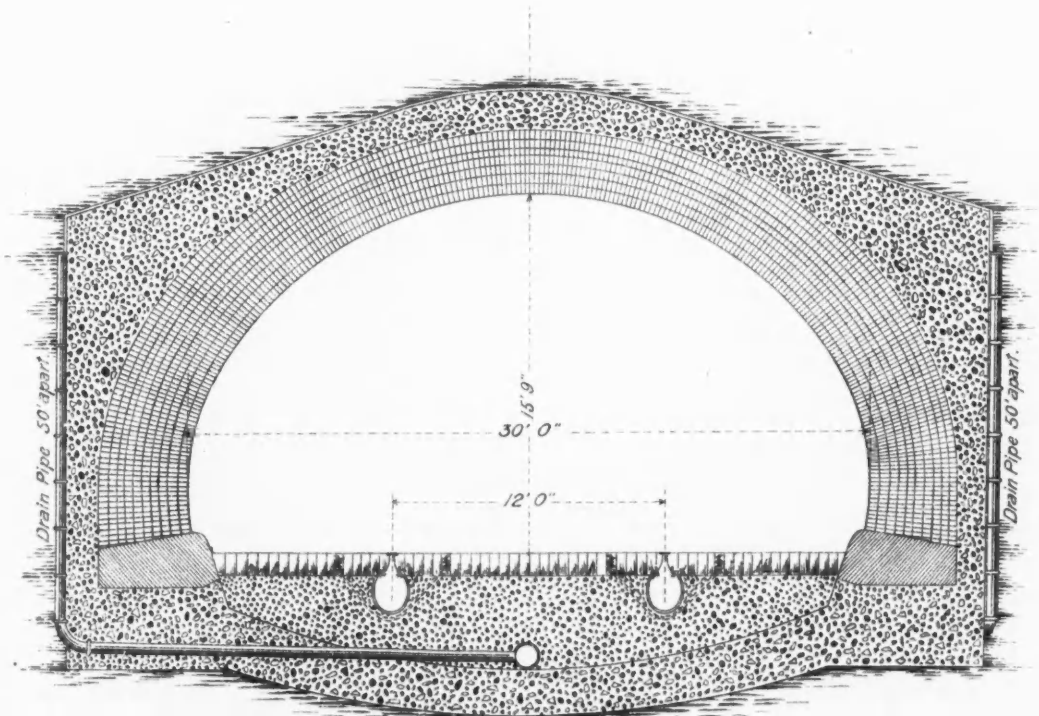

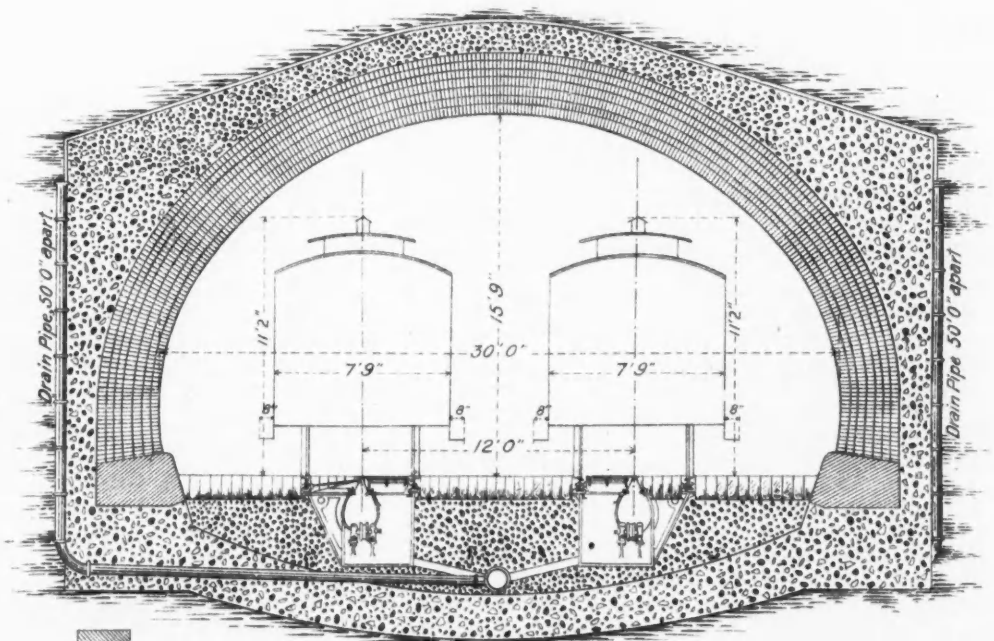

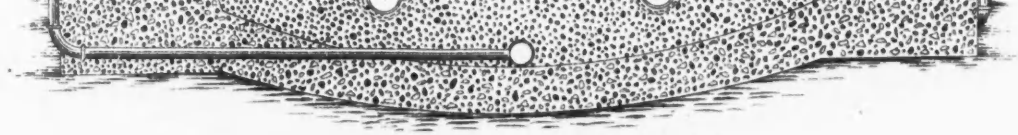

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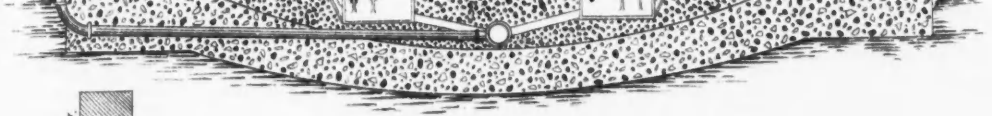

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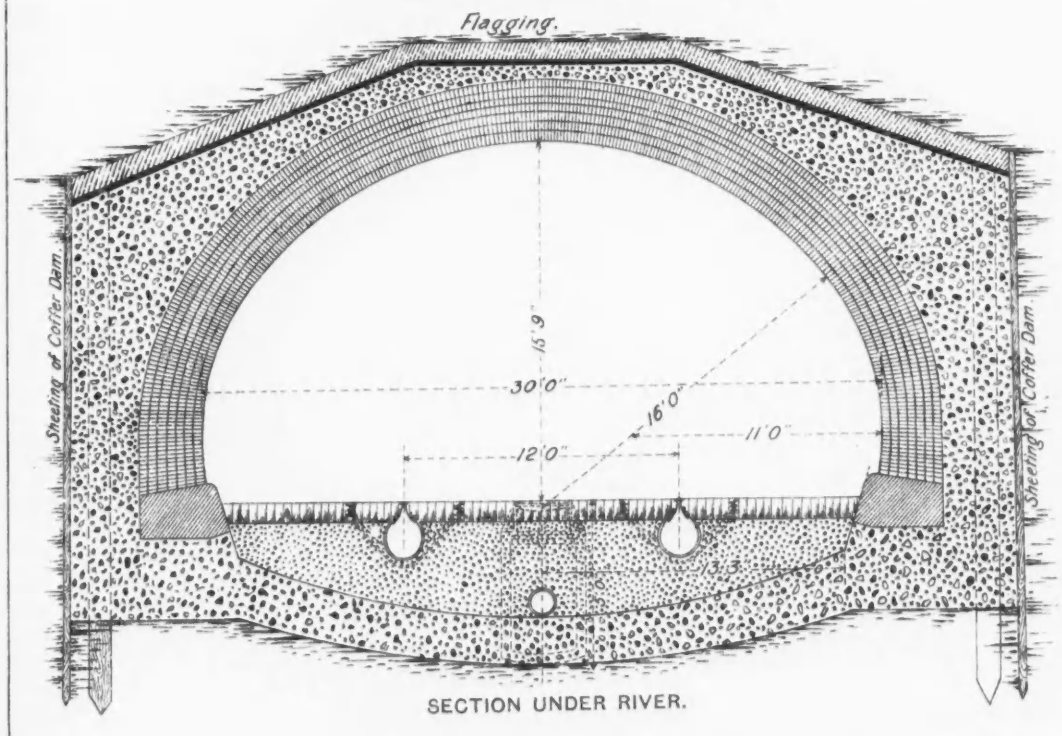

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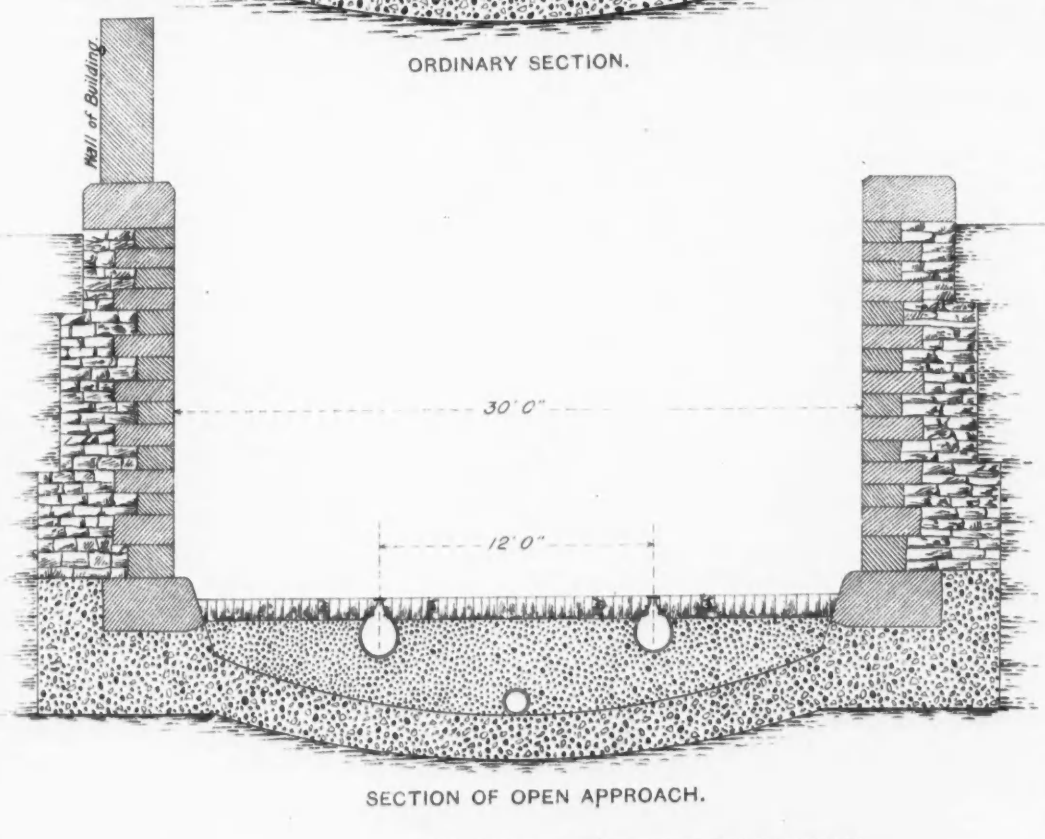

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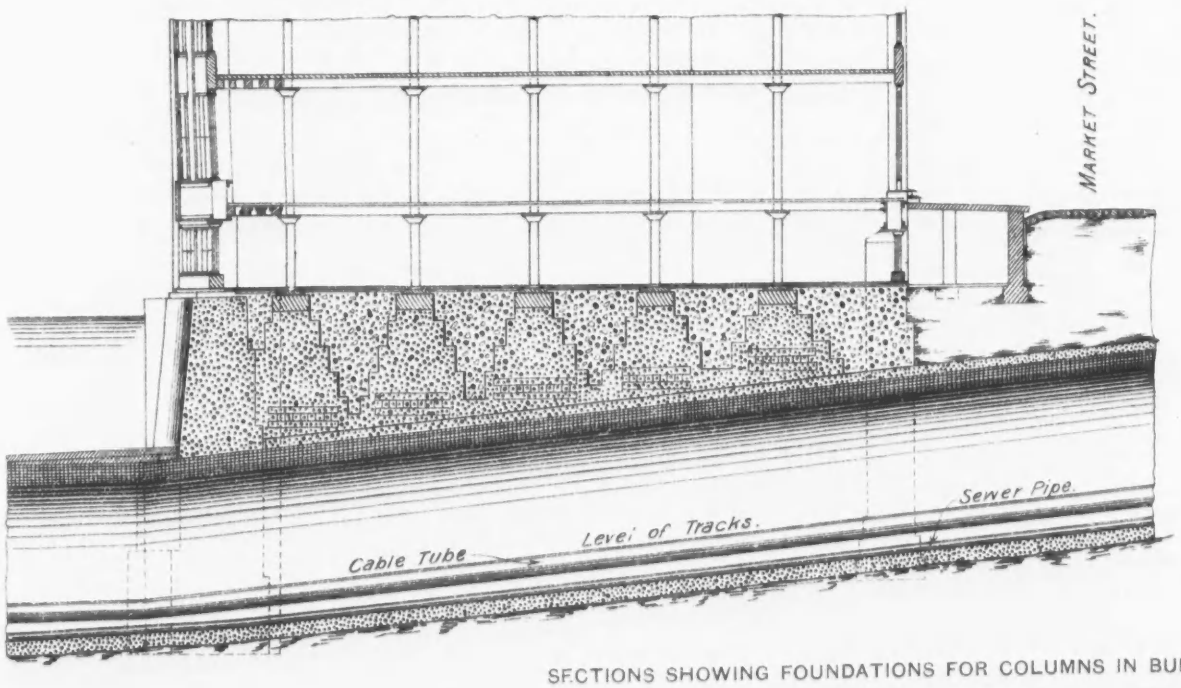
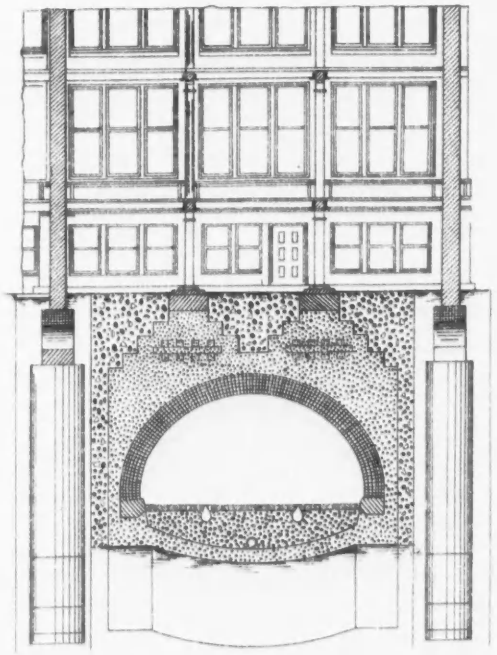




SECTIONS SHOWING FOUNDATIONS FOR COLUMNS IN BUILDINGS.

CHAS. HART & SONS, LITH., 36 VESEY ST., N.Y.

100,000,000 blank cards are wanted for use with the electrical tabulating machines which are expected to save 75 per cent. of the cost of the old-fashioned methods of computing returns. For the use of the mails 75,000,000 free delivery envelopes have been ordered. Stationery Clerk KETCHAM estimates that the material already ordered will fill a room three Washington blocks long and 30 ft. high by 40 ft. wide.

Forced Draught in Marine Practice.

There are few great innovations on established practice in steam engineering which have made such rapid progress as the introduction of the forced draught. A half-dozen years ago the use of forced draught for marine boilers was practically confined to torpedo-boats. Nowadays hardly a vessel is added to the navy of any country without being equipped with forced draught appliances. Nor has the introduction of the forced draught been confined to war vessels. The use of fans giving moderate pressures in the stokehold is becoming more and more common on merchant vessels and even on river steamers. For the "Atlantic greyhounds," where speed is the great desideratum, the forced draught has found especial favor.

But while the forced draught has greatly increased the possible speeds of vessels, by securing a more rapid combustion and evaporation per unit of grate surface and heating surface, the havoc it has played with the boilers of Her Majesty's fleet has secured for it in England a pretty strong array of enemies. Since Great Britain leads the world in shipbuilding and especially in the construction of war ships, in setting about the building of our own new navy we naturally look to her experience for guidance. Should we therefore "take warning" and omit provision for forced draught from the vessels we are about to build?

It would be too much to say that any one has a serious notion of abolishing the forced draught for naval purposes. "He who fights and runs away may live to fight another day," and the ship which can steam a little faster than her adversary may escape capture; or, on the other hand, may overtake her fleeing enemy and secure her as a prize. Naturally, then, no nation can afford to forego the advantages which are given to its ships of war by the use of forced draught in an emergency. The only question is whether its use should be restricted to such emergencies. If such serious and numerous casualties as those which occurred at the British naval review and manœuvres last summer, are inseparable from the use of forced draught, it might well be that the use of the blowers should be restricted to cases of absolute warfare. The case is similar to, though not by any means so bad as, that of the British 110-ton guns, which seem on the whole so dangerous to the ship on which they are mounted and to her crew that nothing but the absolute certainty that a projectile from them was going plump against an enemy's hull would justify the risk attendant on their firing.

In commenting on the accidents at last summer's naval review, *Engineering* said:

> The weak part of the fleet has always been its boilers, but with the advent of forced draught the trouble has been tenfold augmented. . . . The application of forced draught, even to 2 ins. water pressure, renders the boilers of our war vessels unserviceable until they have been doctored up again.

The principal cause of boiler failures with forced draught is leaky tubes; but trouble is also experienced with overheated grate bars and burnt furnace crowns. In fact, however, the trouble indicated by the term leaky tubes is worse than might be thought. The remedy is to make them tight with the tube expander. In time the metal of the tube, heavily strained by expansion and contraction, gives way; and the tube breaks off inside the tube plate, causing an outrush of steam, whose results have in many cases been serious. This may be partially remedied by using heavier tubes, for the restriction as to weight of boilers in the past have led to the use of very thin metal for tubes. The British Admiralty have ordered that boilers of a given power may in future be increased 20 per cent. in weight, which will give the designers much more latitude in this direction.

The necessities of the case, as already stated, will not permit the abandonment of the forced draught in naval use, and it remains to be seen whether the trouble experienced in its workings will result in more sparing use of it in Her Majesty's fleet.

For our own navy, now going forward so rapidly, it is to be hoped that the experience of Great Britain in this important respect may serve as a valuable guide. By this we do not at all mean that the advantages of forced draught should be relinquished; on the contrary, they should be improved to the fullest degree; taking care at the same time to avoid the errors in design through which the boilers of British vessels fitted with forced draught have come to grief. Nor is it to be thought that the subject is of interest only to the naval engineer. The many advantages which can be secured with the forced draught, when properly arranged, can be secured in no other way; and they are so important that it is not too much to expect its eventual adoption for many classes of stationary boilers as well as in marine service.

In ENGINEERING NEWS of Jan. 2, 1886, and Nov. 26, 1887, the theoretical advantages of the forced draught were explained at length. To give a clear idea of the possible gains by the use of forced draught, let us briefly summarize these advantages. They are (1) economy in first cost of plant. A single boiler, working under forced draught, may supply as much steam as a half dozen boilers working under chimney draught. The cost of the engine and blower will be largely offset by the saving in the cost of the chimney. (2) The forced blast tends toward economy in the use of fuel. This is secured in several ways. In the first place, the *air excess* necessary in the operation of the furnace is far less than with a chimney draught, thus avoiding much loss of heat in the chimney gases; secondly, the boiler is so compact that the surface exposed to external radiation is much smaller in proportion to the power generated; again, the use of the forced draught secures a greater intensity of combustion, higher temperature in the furnace, and an ample air supply, all of which conduce to the perfect combustion of the fuel; finally, the use of the forced draught permits the arrangement of flues to take up the heat of the flue gases, and transmit it to the feed-water and to the air supply of the furnace.

Other collateral advantages of the forced draught in enabling the draught to be always adapted to the work at hand, and in making possible great reductions in the weight of steam machinery, are too evident to need further elucidation.

That the forced draught for naval use has come to stay must be acknowledged. Bearing this in mind, would it not be well to change the type of marine boiler for one which can endure the heat of the forced draught? The water-tube boiler for stationary use has now proved its merits by many years of service, and with the exception of the plain cylindrical boiler, which still retains popularity by virtue of its cheapness, is probably the type in most common use. That some type of water-tube boiler will eventually become the standard in marine practice is the opinion of many distinguished engineers. The use of higher steam pressures in multiple-cylinder engines works with the forced draught to favor the use of a type of marine boiler safer and more durable than the old Scotch type, which has served its day so well.

Of course it is undeniable that the difficulties in the design of a sectional steam generator for marine purposes, and especially for naval use, are manifold. Salt water is too severe a corrosive agent for a boiler of present materials to long endure; and provision must be made for the ready repair and replacing of any corroded part, and for the easy discovery of such corrosion by inspection. On the whole it would seem that a boiler built up in sections would be easier of repair than a shell built up of heavy plates, for whose repairing the tedious operations of cutting out and patching must be performed. After all it is doubtful whether the conditions of water supply which obtain in marine practice are any more difficult to deal with than some of the muddy and hard waters which are often used in stationary boilers.

The other chief requirements to be met are good circulation, durability, provision for free contraction and expansion, and compactness. It is not easy to see why these requirements cannot be as well met by some form of water tubular boiler as by the present marine type. At any rate, in judging the relative merits of the two, it should be remembered that the faults of the present type of marine boiler are not few or small, and that in view of the difficult nature of the service, boilers of either the water tube or fire tube type will have defects which would not occur in easier service.

It seems well to emphasize these facts with regard to the water tube type of boiler in order that its designers may not cease their endeavors to produce a successful boiler of this type; and in order that naval engineers may give a fair trial to new inventions in this line regardless of precedent or of failures which have gone before, at least until it is proven that some inherent defect in the type makes it unavailable for work with the high pressures and forced draught of modern practice.

But the difficulties experienced with forced draught have been by no means due solely to the use of an improper type of boiler. It is acknowledged by all that they are largely due to the improper management and careless stoking of the furnaces. To quote again from *Engineering*:

> If we look through the long list of casualties [during the mobilization for the naval review] there are few which cannot be attributed to want of experience on the part of the officers or men. Of course, there is the long series of failures due to forced draught and consequent leaky tubes. These we have already commented upon, but it may be added that much can be done to mitigate this evil by good stoking and skilled management of the boilers when letting down steam.

Also in a recent report of the Chief of the Bureau of Steam Engineering of the United States Navy, occurs the following:

> Now that the time is rapidly approaching when the boilers of all vessels in the navy will be worked under forced draught, steps should be taken to educate the men of the fire-room force up to their new duties. A fireman accustomed only to natural draught becomes demoralized when set to work in a fire-room where the fires are urged to their utmost by powerful blowers. . . . This never struck me so forcibly as when I lately went down New York Bay on board the *Swatara* to witness the working of the machinery. Although the vessel had been in commission for several months the men had had no experience with the forced draught, except during a short trial trip. The fires were miserably worked. A state of affairs which must continue unless the men can have more opportunity to gain experience. . . . We have training ships for sailors, but we vainly imagine that the putting of a man down the fire-room hatch with a shovel in his hand makes him an expert fireman.

So far as this fault is due merely to inefficiency of the men, the designer and builder of the machinery have nothing to do with the matter. But it must be remembered at the same time that some radical changes in design are needed before a marine furnace will be properly worked under forced draught. It has just been shown that a more skilled man is required to feed a forced draught furnace than a natural draught; and this, indeed, is a matter of common experience. A man quite competent to shovel coal into a mill furnace might be wholly unable to keep up steam in a locomotive. But under the conditions which exist in most stokeholds it is a difficult matter to get anything but the most ignorant and clumsy class of workmen for firemen. Not until the stoke-

hold is made cool enough for men to work in it with a reasonable degree of comfort, can competent workmen be expected to apply for employment there, or even a fair efficiency be expected from the furnaces.

But in this case, fortunately, the forced draught offers a ready means of removing the difficulty. The blast of air from outside should circulate first through the fire-room, pass thence to the interior of a thin jacket covering the entire boiler, and finally reach the furnace, heated to a temperature of 200 to 250 degrees. With such an arrangement of the forced draught, the stokehold should be far cooler than when working under natural draught; and the heat saved by passing the air supply to the furnace at a temperature 50 to 100 degrees higher than is now common should have a marked effect in economizing fuel.

We have already alluded to the fact that in the "Atlantic greyhounds" where a maximum of power with a miminum of space are hardly less important than in the navy, forced draught is finding especial favor. But with its introduction and the use of the higher boiler pressures necessary to work triple-expansion engines economically, there has been a notable increase in the troubles with the stokers. The state of things was bad enough before, and the small increase of temperature which these changes have caused has been the last feather which has placed it much too near the limit of human endurance. In an editorial on "Atlantic Racing," some time ago, *The Engineer* said:

> To pass between the boilers is to face a temperature positively frightful; it is almost impossible to let a draught of air through the space, but in many ships coal has to be barrowed through it by the trimmers. When forced draught is used, the heat in the fire rooms rises sometimes in deep ships to as much as 150 degrees. The only consideration is to get air to the fires. If this is done, it is assumed that the men will be all right. There never was a more unwise policy. The engineers are often driven to their wit's end to keep the men up to their work.

For this reason, that the tax on the endurance of firemen and engineers was too great to allow of efficient work—*The Engineer* in the article above referred to advocated the use of the three-cylinder compound engine rather than the triple-expansion, and the reduction of steam pressures to 90 or 100 lbs. If it were true that this scorching temperature in which men are obliged to do hard work could be made bearable in no other way, then this recommendation would have much force; but it remains to be shown that this is the case. Certainly by furnishing blowers enough and providing boilers and furnaces with air-jackets, the temperature of the stokehold could be brought down to a point where men can work in reasonable comfort. On the score of humanity alone, the reform should be set about. It is a disgrace to civilization to have an Atlantic liner come up to her docks with the life literally boiled out of a considerable percentage of her firemen, as the *City of Paris* did last summer. Heretofore this has been regarded as a necessary evil; but if it is once proved by actual trial that it will conduce to economy, as well to provide proper appliances for keeping the stokeholds cool, it may be expected that the remedy will be quickly applied.

It has of course been said and will be said that the advantages in economy claimed for forced draught are merely theoretical, and that in practice it has generally proved more wasteful of fuel than natural draught. But this proves merely that it has not been properly handled; for no amount of experience can overthrow physical facts. If boilers are to be fitted with forced draught merely for use in an emergency, and if the same arrangements otherwise are made as with natural draught, it would be as foolish to expect economy and efficiency from the boilers as to expect an engine to work well with double the pressure and double the speed for which it was designed.

Fortunately, its use has now progressed so far that its total abandonment is out of the question. To drop it in its present stage would be a great step backward; and in marine practice we look to see the present difficulties overcome, and the blower installed as a regular auxiliary and not merely as an emergency appliance on many classes of merchant vessels as well as for naval use. For land use, too, while the first steps have yet to be taken, the gains which may be made by the use of the forced draught cannot long pass unnoticed. The engineer who will first make a reputation for the design of steam generating plants, securing economy through a forced draught, will reap a large reward for his enterprise.

William Jarvis McAlpine.

It will be with much regret that American engineers hear of the death of Mr. McALPINE, an engineer who commenced his professional life almost with the beginning of engineering in this country, and has been prominently connected with many of the public works that have made us what we are as a nation. His death following so soon after that of Mr. ALLEN teaches us that the roll of pioneers in the engineering development of the United States is rapidly growing very short; a few are still left with us; some enjoying vigorous old age; others are feeble in health but vigorous still in intellect: for the life work of the engineer, while, as a rule, wearing upon the physical man, tends to sharpen and develop the mental faculties, and preserves them to the last.

This was particularly the case with Mr. McALPINE, who, though suffering in health for some years previous to his death, never lost his lively interest in all matters pertaining to his profession, and was ever ready to discuss its details, and to give from his storehouse of ripe experience counsel and advice to young and old. His name and fame as an engineer were known on two continents, and will be ever connected with some of the greater works of engineers. As a man he was most genial and companionable, a favorite in every company, a loving and beloved parent, and a staunch and firm friend.

He was methodical in his habits to an eminent degree, carefully recording his work wherever he might be, in his study or in the field; and his voluminous and minutely detailed professional notes on every work with which he has been connected are not only the record of a long professional career, but they also preserve a vast fund of data usually inaccessible to engineers in book form, and of correspondingly great value. It was from this store of details, noted down when the conditions were all fresh and known, and the practice before his eyes, that Mr. McALPINE was enabled to often supply a missing link in theory, and to prove by actual practice that premises assumed were either false or true.

His life story as an engineer is very meagrely outlined in our present issue; but we hope to shortly present a fuller account more in accord with the long professional career of WILLIAM JARVIS McALPINE, a founder and past President of the American Society of Civil Engineers, and the first American engineer to be elected a member of the Institution of Civil Engineers, the foremost and most powerful body of its class in the world.

CORRESPONDENCE.

English and American Locomotives.

CONNELLSVILLE, Pa., Feb. 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR—In your last issue there is an article on "English vs. American Locomotives," wherein it says that a good majority of the new English locomotives are of the American type in certain prominent features. Will you kindly tell me what these features are. H. W.

[Primarily, the leading truck or "bogie," as the English term it, and the equalizing levers. Outside cylinder engines are also in increasing use, and certain imitations of the eight wheel, mogul and consolidation types are appearing from time to time. ED. ENG. NEWS.]

Methods of Stadia Work.

SYRACUSE, N. Y., Feb. 10, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to Mr. FORD'S letter on page 136, of your issue of Feb. 8, suggesting a horizontal rod in place of a vertical rod for use in stadia measurements:

I shall not undertake to speak as an expert, as personally I have used the method but little. My first experience in the use of the stadia was while in charge, as engineer on the part of New York, of the survey of the boundary line between that State and New Jersey, several years ago, Prof. BOWSON, of New Brunswick, being my New Jersey colleague. The detailed measurements were all made by this method by our transitman, Mr. (now Professor) TITSWORTH, of Rutgers College, under my constant personal supervision. In the open country, where the only obstructions to sight were the tall grass and weeds or low bushes, which might make it difficult for the transitman to see the lower or zero mark of the rod, unless the latter were elevated upon a high stake or stump, to avoid, perhaps, the waste of time necessary for the bush-hook to clear the way, the idea of using a horizontal rod was suggested, more as a possible means of facilitating operations and of avoiding the effect of heated air upon the sight of the lower target on a sultry day, than of obtaining more accurate results. As we were running a series of careful transit lines, and obstructions over a foot or so in height having to be removed, a vertical rod answered our purposes entirely. But in the woods the objections to a horizontal rod are quite patent. The woods on the Jersey line may be emphatically designated as a "dense forest." The heavy timber having been cleared off in the mountainous region, the entire area is covered with a thick growth of saplings and bushes, deadened in many instances by fire, making progress to depend entirely upon the skill and activity of the axemen. And for the detail lines, along which the measurements were taken, the vistas through these thickets were rarely more than two or three feet in width. In fact, upon favorable ground, a slit, a foot wide, answered our purposes. A horizontal rod in such running, which covered the more interesting portion of the line, topographically speaking, would have required more than double the time it took to clear the way for the vertical rod. Upon the Pennsylvania boundary also, the 250 miles of which are two-thirds covered with thick woods of all kinds, from bushes and saplings to the heaviest kind of timber; where in many places transit running progressed slowly, day after day, with incessant chopping, a horizontal rod would have been an incumbrance. With a good telescope, a sharp eye behind it, and a powerful field glass in the hands of the flagmen, a vista two feet in width will answer as well as one six feet wide, for much longer distances than can be measured with the stadia at one sitting. I myself, in one instance, "bored" such a hole more than five-eighths of a mile across a thick black ash and alder swamp without moving the instrument. The measurements in this instance were chained. To have cleared the way for the use of a horizontal rod for even 500 ft. observations, would have required double the labor.

I have thus endeavored to suggest one practical objection to the use of a horizontal stadia rod. Mr. FORD may be able by judicious management to locate all his stations in the dense forest specified in his second paragraph, so that each can be seen from the next without any chopping, but it will be a matter of sheer luck if he can from even one of his series see two targets from two to five feet on either side of another station.

The other errors which he wishes to avoid by using a horizontal rod seem to me more imaginary than real. By using a vertical rod, which is easily kept plumb by the rodman by means of the attached levels, he will not have to correct for inclination of the rod, and his extreme care to keep a constant height of instrument above his stations is unnecessary. He has the angle of elevation, or depression, of the next station, for each observation, by means of which the inclined distance may be reduced to horizontal, to which there is only to be added the instrumental focal constant.

And in tracing the vertical contour of his line it would be better to measure the actual height of instrument above each station peg than to undertake the almost impossible feat of setting his transit up at a "constant" height in rough or soft ground.

H. W. CLARKE,
M. Am. Soc. C. E.

The Illinois River Bridge Accident

PEORIA, Ill., Feb. 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I take the liberty of sending you the enclosed photographs of the break which occurred on Monday, Feb. 3, in the bridge crossing the Illinois River, at the lower end of this city, called the "Peoria & Pekin Union Bridge," it being owned and operated by that company

and used as an entrance to Peoria by the Ohio, Indiana & Western, the Peoria, Decatur & Evansville, the Jacksonville Southeastern and the Lake Erie & Western railroads.

The bridge went down at about 6:30 P. M., just as a heavy consolidation engine of the O. I. & W. was passing onto the second span. The engine was an eight drive wheel, 86-ton (with tank and load) consolidated, and was pulling a train of 30 cars loaded mostly with grain. The train was moving very slowly; the bridge went down perfectly straight, leaving the track "in line;" the tender and cars did not leave the track, and the bridge was not collapsed in the middle by the weight or shock, nor did the other end leave the abutment (as is shown in the general photograph). The span was 125 ft. long, a combination diagonal post structure rebuilt in 1881 by Rust & Coolidge, of Chicago. I send by permission of the railroad a blue print of the dimensions and positions of members as in original contract, and upon examination they are found to be as large or larger in the structure itself. These members were critically examined Jan. 1, 1890, by F. E. McMath, of Detroit Bridge & Iron Works, and pronounced in good condition at that time.

No satisfactory cause of failure of the span has yet been discovered. The only break in the iron is found in the eye of rod from the endpost on the right side to the foot of first diagonal post; it was the eye in the top chord and shows a flaw. This does not seem sufficient for failure of the span, without some breakage of timber occurring before the bridge fell, and it is impossible to find any breaks in the timber which certainly occurred until caused by crushing against the pier. The only break in masonry is in the coping on left side, in line with the truss. On that side the coping projected much more than on the right side, and appears to be caused by the contact of the top chord as it fell, and not to have caused the fall.

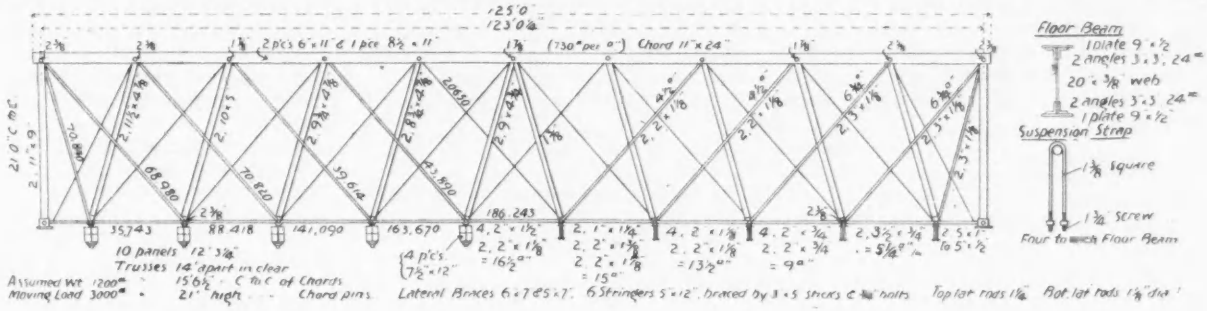
I observed for Mr. Chas. Hansel, by direction of the Illinois Board of R. R. & W. Commissioners, tests of the remaining five spans of the "P. & P. U. Bridge" on Feb. 10 and found under a load of 2,680 lbs. per lineal foot, moving load, deflections as follows (I report centre panel deflections only):

2d span	150 ft.	camber,	0.32 in.	def.	0.12 in.
W. end draw	150 "	"	0.00 "	"	0.09 "
E. end draw	150 "	"	0.00 "	"	0.10 "
4th span	150 "	"	0.35 "	"	0.14 "
5th span	150 "	"	0.38 "	"	0.15 "
6th span	150 "	"	0.30 "	"	0.17 "

After running three engines together (weight, 402,000 lbs.) back at 6 miles per hour, readings taken at once showed full recovery to normal position.

Mr. T. B. Burnett, Superintendent of P. & P. U. R. R. has arranged to send the fractured iron to the Pittsburg laboratory for analysis and report. Yours truly,

R. R. Bourland.


125'0"
123'0"
Floor Beam
1 plate 9 × ½
2 angles 3 × 3 × 24"
20 × ⅜ web
2 angles 3 × 3 × 24"
1 plate 9 × ½
Suspension Strap
1⅜ square
1⅜ screw
Four to each Floor Beam
10 panels 12' 3⅛"
Trusses 14' apart in clear
Assumed Wt 1200#
Moving Load 3000#
15'6½" C to C of Chords
21" high
Chord pins
Lateral Braces 6 × 7 85 × 7
6 Stringers 5 × 12", braced by 3 × 5 struts & ⅝ bolts
Top lat rods 1⅛
Bot. lat rods 1⅛" dia.

Accident at Illinois River Crossing, Peoria & Pekin Union Ry.—Side Elevation of Truss which was Wrecked.

The Properties of Aluminum, with Some Information Relating to the Metal.*

PURITY OF ALUMINUM AND PROCESSES OF MANUFACTURE.

A great deal that has been written heretofore about the properties of aluminum is of doubtful value, owing to the lack of knowledge we have of the purity of the aluminum referred to. Much of the metal heretofore sold in the markets as pure aluminum has been contaminated with from 4 to 10 per cent. of impurities. Indeed, it is only within a very few years that a purer metal than 95 per cent. aluminum has been made upon any larger than a laboratory scale.

The works of M. Pechinet, of the Société d'Anonyme d'Aluminum, at Salinderes, near Marseilles, in France, have longest enjoyed the reputation of making the purest aluminum placed upon the market. The method employed is essentially Deville's, reducing aluminum chloride by aid of metallic sodium, the same as practiced by the Aluminium Co., Ltd., at Oldbury, England; with the modification of using aluminum fluoride, instead of aluminum chloride, to be reduced by the sodium, this is also the method pursued by the Alliance Aluminum Co., of Wallsend-on-Tyne, in England.

The Pittsburg Reduction Co., manufacturing under the Hall process, reduce the metal from aluminum oxide, alumina (Al_2O_3), by electrolysis; this alumina being held in solution by a molten fluoride bath, which itself is not decomposed by the electric current, which is conveyed to the melted solution by means of carbon cylinders placed in the bath for positive electrodes, a carbon-lined pot forming the negative electrode. The oxygen of the alumina goes off at the positive electrode as carbonic acid, wearing away the carbon at the rate of nearly a pound of carbon to the pound of aluminum produced. The reduced metal settles to the bottom of the pot, from which it is easily tapped or ladled off, practically free from the electrolyte; a second re-melting entirely purifying from it.

All four of the above firms have succeeded in making aluminum of 99 per cent. purity, although it is only with careful selection of materials, and the greatest care to prevent contaminations, that metal of this purity is obtained by any of these processes. All of these firms have succeeded in regularly placing upon the market metal in considerable quantities of over 98 per cent. purity, and these are the only firms, so far as has reached the knowledge of the writers, who have done so.

The impurities of the metal made by "the sodium process," as practiced by the first three mentioned concerns, have been nearly half iron and half silicon. With the Pittsburg Reduction Co. the impurity consists almost entirely of silicon; the iron being less than one-tenth of one per cent. Between Dec. 1 and Dec. 24, 1889 (the plant was shut down for repairs, the first time since Nov. 28, 1888, from the day before Christmas until New Year's), 1,250 lbs. of aluminum was made by the Pittsburg Reduction Co., all of which was over 98.25 per cent. aluminum, with less than 0.10 per cent. iron, and with about 1.50 per cent. silicon; and quite an amount of this metal was over 98.75 per cent. aluminum.

A singular fact is that quite a portion of the silicon in aluminum exists in the graphitoidal state. This was pointed out by Mr. H. J. Williams, when chemist of the Pittsburg Reduction Co., in *Trans. Am. Inst. Mining Engineers*, Vol. XVII., page 542, and also was recognized by Deville in his researches. In aluminum containing 0.20 per cent. silicon, made by the Alliance Aluminum Co., Ltd., we have found 3.85 per cent. of graphitoidal silicon. In a sample of aluminum made by the Pittsburg Reduction Co., using calcined native bauxite as an ore, containing 5.30 per cent. silicon, 2.50 per cent. existed in the graphitoidal state.

The following table gives the average composition of the metal of the various makers, of given percentages of contained aluminum, as shown by many analyses made by the Pittsburg Testing Laboratory:

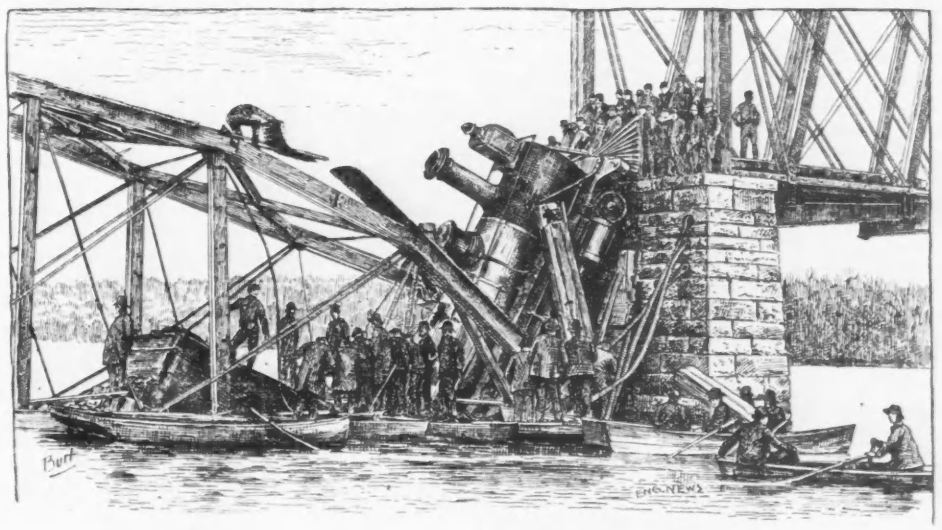
Aluminum metal made by	Per cent. aluminum.	Per cent. combined silicon.	Per cent. graphitoidal silicon.	Per cent. iron.	Per cent. copper.	Per cent. sodium.	Per cent. lead.
The Pittsburg Reduction Co	95.0	1.50	1.35	2.00	0.07	0.04	0.03
The Société d'Anonyme d'-Aluminum	95.0	0.90	1.00	3.00	0.05	0.01	0.04
The Alliance Aluminum Co., Ltd	95.0	0.90	0.75	3.25	0.02	0.07	0.01
The Aluminum Co., Ltd., Newhausen	95.0	1.75	1.15	2.00	0.01	0.07	nil.
The Société d'Anonyme d'-Aluminum	99.0	0.35	0.13	0.50	nil.	0.01	0.01
The Alliance Aluminum Co., Ltd	99.0	0.31	0.20	0.45	nil.	0.03	0.01
The Aluminum Co., Ltd	99.0	0.27	0.15	0.55	0.02	0.01	nil.

PROPERTIES WITH REFERENCE TO SPECIFIC GRAVITY.

One of the most striking properties of aluminum is its lightness, which, for many purposes, makes it comparable in value with metals costing one-fourth as much.

[The author here gave a table of specific gravities as determined by various authorities. Roscoe & Schorlemmer give 2.56 for cast metal and 2.67 for hammered metal. Deville gives 2.60 for cast metal, absolutely pure, at 4° C. The Pittsburg Testing Laboratory found 2.587 for a bar sawed from the centre of a cast ingot, and 2.71 for an average lot 98.52 per cent. aluminum in sheets .0625 in. thick.]

The specific gravity of aluminum being taken as 1, soft steel is nearly 2.95 times as heavy, copper 3.6 times as heavy, ordinary high brass 3.45 times as heavy, nickel 3.5 times as heavy, silver 4 times as heavy, lead 4.8 times as heavy, gold 7.7 times as heavy. A sheet of aluminum 12 ins. square and 1 in. thick weighs 14.03 lbs.; a bar of aluminum 1 in. square and 12 ins. long will weigh 1.17 lbs. A bar of aluminum 1 in. in diameter and



Wreck of Illinois River Bridge—From a Photograph.

*A paper, by Alfred E. Hunt, Jno. W. Langley and Chas. M. Hall, read at the Washington meeting of the American Institute of Mining Engineers.

12 ins. long will weigh 0.918 lbs. A cubic inch of cast aluminum weighs 0.092 lb.

1 cu. ft. of cast aluminum weighs 158,967 lbs. 1 cu. ft. of wrought iron weighs 485,874 lbs. 1 cu. ft. of ordinary brass weighs 524,160 lbs.

Aluminum has about the tensile strength of cast iron, with only about one-third of its weight, and casts equally as easily and successfully, and will, herefore, be very advantageously used to replace cast iron in the parts of moving machinery that have to be reversed or otherwise have their momentum overcome; for with one-third the weight, and consequently one-third the momentum, aluminum will work very satisfactorily.

ACTION OF HEAT ON ALUMINUM.

Pure aluminum melts and becomes fluid at about 1,200° Fahr. The amount of impurity in aluminum materially alters its melting point. One per cent. of iron raises the melting point over 100°. It does not remain firm like lead almost to the fluid point, and then suddenly give way, but has a stage of from 1,000° Fahr. to 1,200° Fahr. in which the metal becomes pasty, loses much of its power of cohesion, and during which stage, if the metal be gently pressed together, it can be readily welded. It is however, very red-short at this temperature, and will not stand hammering to weld the metal without crumbling down. If the metal is not held too long a time in this pasty condition it does not seem to become injured after being again cooled down.

The Thomson Electric Welding Co. have no difficulty in satisfactorily, rapidly and cheaply welding aluminum in such ways that the welded strip will break in the body of the bar, by their admirable machines, which are so designed that the surfaces to be welded are brought together automatically at the welding temperature (near the fusing point in many metals, and a temperature at which the rigidity is nearly lost in them all), in just such a way that the welded faces will cohere without changing the form of the constituent parts.

The melting point of aluminum, as given by Roscoe & Schorlemmer and by MIERZINSKI, is 700° C., or 1,292° F.; by DEVILLE, at a temperature higher than zinc and lower than silver; by FAHQUHARDT, at 700° C., or 1,400° F.

MALLET says pure aluminum is more infusible than impure.

The metal of the Pittsburg Reduction Co. has been subjected to many tests, which will be referred to later in this article, and for the sake of brevity in identifying it we shall call it the Pittsburg Reduction Co, "average lot 98.52% aluminum."

The metal was of the following composition:

Al, 98.52%. Si combined, 0.42%. Si graphitic, 0.72%. Fe, 0.05%. Cu, 0.06%. Pb, 0.04%. As, none. S, none. P, none. Ca, trace. Na, trace.

Aluminum, in a compact mass, is an absolutely "fixed" metal, at any temperature attainable by combustion of carbon in the most approved furnace, although in thin beaten foil aluminum burns in a current of oxygen gas. An experiment made by one of the authors, by heating a weighed amount of aluminum in a carbon-lined crucible for several hours—in a Sefström furnace, at a temperature considerably above the melting point of steel—showed that the resulting buttons of aluminum contained all the original aluminum melted, plus several per cent. of carbon, which formed a tenacious, closely adhering skin upon it. The metal, however, had become quite brittle and had largely lost its cohesive powers. DEVILLE, WATTS, and FREMY, all say that aluminum is absolutely fixed at all temperatures and loses no part of its weight when highly heated.

Aluminum remains in a molten condition without any slag over it, and requires no flux; indeed most fluxes are absolutely injurious, in that they assist the metal in absorbing silicon and iron from the lining walls of the containing crucible; charcoal and other light substances which are sometimes used to cover the molten bath, are very difficult to keep from contaminating the castings, and are of no use whatever.

Molten aluminum takes a very thin coating of oxide of aluminum on its surface, which seems to protect the liquid metal underneath it. This thin coating can be discovered by drawing a rod of aluminum across the surface of the bath and noting the brightened surface of the metal in the stroke made by the rod parting the surface film. It is not our experience that this film of oxide is of serious consequence in preventing sound castings or causing flaws in rolled sheets or bars.

Aluminum had best be melted in first quality plumbago crucibles, from which it absorbs only about 0.25 per cent. silicon with each remelting. In melting in clay, Battersea, or other silicious crucibles, aluminum becomes very seriously contaminated with silicon.

For purposes where it is especially desirable to retain the purity of aluminum, it is best to remelt in crucibles brasqued or lined with a mixture of finely ground, "dead burned," calcined, pure magnesia, with just enough boiled tar to give it sufficient plasticity; this mixture entirely prevents the molten aluminum from coming in contact with the silica in the clay of the crucible walls.

Heated in an atmosphere of chlorine gas, aluminum burns to a chloride. Moist chlorine gas, even in the cold, acts energetically upon aluminum.

Aluminum is most malleable at a temperature between 200 and 300° Fahr., although it can be rolled cold with frequent annealing. It should not be worked at a temperature above 400° Fahr., for it becomes very red-short at a temperature a little above this point. Aluminum becomes quite hard by work upon it, either by cold-rolling, hammering, or drawing. Through wire dies, it assumes nearly double its normal tensile strength, although it does not, like steel, lose proportionately as much of its "ductility" as measured by the flow of the metal in reduction of area at point of fracture. In rolling or drawing aluminum, like the precious metals, it requires frequent annealings to prevent its cracking.

This annealing is accomplished by heating the metal to a temperature of about 800° Fahr. It is a temperature at which a thin bar of iron placed in the muffle will just appear slightly red on a dark day or at twilight. The aluminum at this temperature should not appear at all red. This temperature can best be determined in a practical way by drawing a soft pine stick across the surface of the aluminum to be annealed; it should leave a black mark from the charring of the wood, which should burn off very slowly, or not at all. After being heated to this temperature the metal should be allowed to cool off very gradually, although a very satisfactory anneal ing of light articles can be attained by plunging them in water of between 60° and 100° Fahr.

For some articles, where it is necessary to keep the heat down below the point where the metal would sag or lose its shape, a very satisfactory annealing can be done by heating the articles in boiling linseed oil and allowing them to gradually cool with the oil. Very thin sheets and wire can be annealed by plunging into boiling water and allowing to cool with the water. Aluminum as annealed is very soft and pliable indeed; in fact, as compared to its tenacity, it is probably the most pliable of metals.

Aluminum on slowly cooling from fusion crystallizes in octohedrons, and castings on fracture show a fine-grained crystalline structure. Pulled in a testing machine, the fracture shows granular.

An ingot of aluminum high in silicon was melted in a plumbago crucible, and one portion cooled in a very cold and thick-walled ingot mold, into a very thin ingot, in a way to give the metal as much of a chill as possible; the other portion of the metal was cast in a hot mold and into a thin ingot. The metal of the outside of each ingot was analyzed, with the following results:

	Metal chilled rapidly. Per cent.	Metal cooled slowly. Per cent.	Original metal as first made Per cent.
Aluminum	96.55	96.52	96.60
Iron	0.24	0 24	0.24
Combined or amorphous silicon	1.08	1.34	1.24
Graphitic silicon	2.13	1.90	1.92

So far as it will be fair to generalize from this single experiment, graphitoidal silicon is not rendered amorphous, or combined, as would be the case in chilled iron under the same circumstances. To support this view, no appreciable difference in hardness can be determined between surfaces of ingots cast in chills over those cast in hot molds.

The specific heat of aluminum is 0.2143, water being taken as 1.000. As given in RICHARDS on "Aluminum":

"MALLET gives the specific heat of aluminum as 0.2253.

"FREMY gives the specific heat of aluminum as 0.2181."

Aluminum follows the general rule of specific heats—that they are inversely as the atomic weights.

Aluminum expands under heat as follows:

The coefficient of linear expansion, as determined by one of the authors of this paper, of rolled rods of aluminum (of the average of the Pittsburg Reduction Co.'s 98.52 per cent. aluminum, above described) is approximately, per degree Centigrade between the freezing and boiling points of water .0000206; that of wrought iron, by the same method, being .0000122. From this it is apparent that aluminum has a coefficient of expansion closely approaching that of tin, which is .0000217, and higher than copper, which is .000017182.

Sound castings can be readily made of aluminum, using dry sand molds. The molds can be advantageously lined with plumbago. The metal should be poured quickly, and at very little above the melting point; otherwise the castings will be unsound. Molten aluminum floats readily; and not much larger gates are needed than with brass.

The shrinkage of average aluminum castings made by the Pittsburg Reduction Co. is about $0.\frac{11}{64}$ ins. to the foot, as measured by an Olsen's shrinkage testing machine. The shrinkage can be reckoned to be about 2.26 per cent. of the length of the mold ordinarily.

CORRODIBILITY.

Aluminum becomes covered by a very thin, almost imponderable, coating of oxide on its surface exposed to the atmosphere, which seems to protect it from further oxidation. This coating is so thin as to hardly in any way interfere with the surface polish which the metal takes, and does not change the weight of the metal as determined by the most delicate of chemical balances. In the chemical laboratory of the Pittsburg Testing Laboratory we have a thin weighing scoop hammered out of an aluminum sheet, which weighed 2.2086 grammes eight years ago; it has not changed in weight one-tenth of a milligramme since. The popular general statement that aluminum is unacted upon by air, either moist or dry, or by water, is, therefore, practically true.

According to DEVILLE, water has no action on aluminum, either at ordinary temperatures or at the boiling point. The accuracy of this statement the authors have very freqently verified, finding aluminum wire subjected to the action of steam and heated air to retain its original polish and not to lose weight after six hours' exposure.

Aluminum containing sodium is rapidly acted upon by hot water, dissolving out the sodium and leaving the aluminum spongy and weak, fit only to be remelted, whence it comes out purer and better in quality for its freedom from the sodium.

Aluminum is unacted upon by either concentrated sulphuric or nitric acids; hydrochloric acid is its natural solvent; and when either sulphuric or nitric acid is contaminated with any hydrochloric acid, even though in very small proportions, they rapidly corrode aluminum; the hydrochloric acid forming chloride of aluminum, which in turn is converted into sulphate or nitrate, the hydrochloric acid being again set free in a nascent state to again attack the aluminum, and in this way the corroding chloride acts as a carrier for the sulphuric or nitric acid.

Aluminum is unacted upon by sulphuretted hydrogen, carbonic oxide or carbonic acid gases, or by sulphurous acid or other sulphur vapors. The facts add much to the value of aluminum for many purposes where the tarnishing of silver is a serious inconvenience.

It is also practically unaffected by common salt, either wet or dry, or by sea water, or by weak solutions of salt in acetic acid.

A piece of aluminum $3\frac{3}{5} \times 1\frac{1}{2} \times \frac{3}{32}$ ins. was immersed for 23 days in a 3 per cent. solution of common table salt, at a temperature of 80° Fahr. The strip lost 0.025 gramme in weight; 4.27 sq. in. were exposed; this would give a loss by corrosion per sq. in. per week of 0.00178 gramme. A similar strip was immersed for a similar length of time, under like conditions, in a solution of 3 per cent. common salt with 2 per cent. of No. 8 acetic acid. The action in this case was not confined to that portion immersed in the liquid, but a crust of basic salts was also formed on the portion of the plate above the liquid. The strip was frequently reversed end for end in order to equalize the action. This piece lost 0.165 gramme upon an area of 6.4 in., and the loss was at the rate of 0.00785 gramme per sq. in. per week.

These solutions were chosen as fairly representing extreme conditions to which aluminum would be subjected for domestic culinary operations. This corrosion is very slight and of no practical consequence, being much less than tin plate or silver plate would suffer under similar circumstances.

Solutions of the caustic alkalies readily attack aluminum. In ammonia, aluminum is turned gray in color, but does not lose weight or strength. Chlorine, bromine, iodine and fluorine attack aluminum and corrode it.

Aluminum is unacted upon by organic secretions, such as sweat, saliva or the like, and the metal is finding considerable uses by dentists in the metal plates upon which to back false teeth, as well as by surgeons in tracheotomy tubes, etc.; for these purposes, the aluminum should be free from iron, as it is found that where iron is present in the aluminum, the metal is acted upon by the saliva.

MECHANICAL PROPERTIES.

Aluminum naturally is very soft metal.

The results of a drop testing machine of the Pittsburg Testing Laboratory, in which an accurately ground hardened steel point of 60 degrees, centrally fixed, in a weight of 32 lbs., falling in guides a distance of 24 ins., were as follows:

	Material.		Kind.	Depth and diameter of point mark.
1.	Aluminum	⅛ in. thick	Rolled.	.140 × .28 ins.
2.	"	" "	"	.144 × .30 "
3.	"	" "	"	.143 × .30 "
4.	"	½ in.	Cast	.176 × .32 "
5.	"	" "	"	.177 × .32 "
6.	"	⅓ in.	"	.145 × .29 "
7.	"	" "	"	.144 × .29 "
8.	"	⅝ in.	"	.177 × .32 "
9.	Brass	⅛ in.	"	.145 × .26 "
10.	"	" "	"	.142 × .26 "
11.	"	¼ in.	Rolled	.129 × .24 "
12.	"	" "	"	.129 × .24 "
13.	Copper	⅛ in.	"	.111 × .24 "
14.	Zinc	¼ in.	"	.118 × .24 "
15.	"	" "	"	.111 × .24 "

These results show only partially the difference in the surface hardness, due to working aluminum when cold; castings of aluminum, made a little larger than the finished object desired and drop-forged in dies, are very considerably hardened and made more rigid. For many bearings where great weight does not have to be sustained, as for bearings of surveying instruments, the metal hardened in this way answers very satisfactorily.

Wire and sheets of aluminum can be left in this hardened state, having the hardness of brass, and with a good deal of elasticity and spring in them. The Eureka Tempered Copper Co., of North East, Pa., have succeeded in hardening castings of aluminum in the same way they have hardened copper. Their hardened aluminum castings are on exhibition at the Washington meeting.

As already noted, the most careful and delicate tests have failed to show the slightest hardness given to aluminum by the process of "chilling" as practiced with cast-iron. The surface of the metal poured against the cold, hard metal surfaces seems as soft as any other portions of the same aluminum.

Pure aluminum is one of the most ductile and malleable of metals, and can be drawn into the finest wire and rolled to sheets $\frac{3}{10000}$ in. thick. It can also be hammered into foil as thin as gold leaf. The relative malleability of aluminum, as shown by its capacity to beat out well into thin foil, is one of the best tests of the purity of the metal. The less percentage of silicon and iron in the metal, the better and more readily it works up under the beater's hammer. Metal with more than one per cent. impurity will not beat out well into foil.

Pure aluminum is absolutely non-paramagnetic; the same remark practically applies to aluminum with 0.05 per cent. iron in its composition.

A wire of the average lot of 98.52 per cent. aluminum, suspended by nearly torsional chord, exhibited no appreciable polarity.

An ingot of aluminum, containing .15 per cent. iron, showed a very faint trace of polarity; with 2 per cent. iron the polarity was distinct and very decidedly marked.

All commercially pure aluminum sold by the Pittsburg Reduction Co. contains less than 0.20 per cent. iron, much of it running as low as 0.04 per cent. iron. For this reason, aluminum will answer very well for compass boxes or cases for electrical apparatus, where non-magnetic properties are desirable. There are very few commercial metals not chemically pure containing as little iron as does aluminum; certainly all of the brasses, bronzes, or german silver contain a larger percentage of iron.

(TO BE CONTINUED.)

Carbonic Acid Gas as a Fire Extinguisher.

The Glasgow *Weekly Mail* gives an interesting account of a coal mine in Ayrshire which has been burning for 40 years, and of a vain attempt to extinguish it with carbonic acid gas, which we condense as follows:

It was on Sept. 6, 1849, 40 years ago, that the fire broke out in one of the Dalquharran pits. There were at least two seams of coal, and when the shaft reached a depth of a little more than 180 ft. the borers came to a hard trap dyke. The coal took a sudden angular dip, and consequentiy it was necessary to place an engine and boiler at the foot of the first shaft in the dry level, so as to raise the coal from the bottom seam. The boiler was laid on a base of coal, and it was built in with bricks so as to prevent actual contact with the coal itself. For nearly 20 years everything went well; but all that time the heat from the fire and from the boiler was acting on the coal that was in contact with the bricks. It only needed an accident to set the shaft on fire; and on that early day of September, 40 years ago, the accident occurred. It was more a mishap than an accident. The fire was drawn from the furnace. There was at the time a fall from above; the miners fled for their lives, and next morning the flames were roaring up the shaft and towering above it to a height of 30 ft., a perfect column of burning fire. By degrees the fire went down, but it did not forego its hold. It seized upon the seam, and from that day to this it has gone on burning, slowly, steadily; its progress marked by depressions in the ground, by fissures and seams from which flames have issued and steam curled, by calcined rocks and by trees and bushes burned and blasted. There are still indications that the conflagration has not completely exhausted itself where it first broke out. In the hollows all round there were large trees and a wealth of underbrush. The trees are gone. Where the surface has long since cooled younger trees have taken their place, but close by them and at intervals over a considerable portion of ground there are rents in the rock and in the soil, and out of these the steam never ceases to ascend.

A serious attempt was made some years ago to put the fire out, and with disastrous results. A "gentleman from London" came down at the instance of the proprietor, and erected machinery for the purpose of forcing carbonic acid gas into the workings, the intention being to destroy the oxygen on which the fire was nourished and so extinguish the conflagration. A mine was driven into the neighborhood of the fire, and for a week the destroying gas was forced in without ceasing. But instead of putting out the fire, the heat kindled another. And what seems most remarkable, if it be true, is that the new fire was started in a portion of the seam absolutely safe from the original burning, being shut off from it by a trap-dyke which of itself would have prevented the fire spreading toward the present field of its operation. The effort to extinguish the conflagration was, of course, vain, and, in addition, some £2,000 was literally thrown into the fire.

Nevertheless, there have been many cases in which carbonic acid gas has extinguished mine fires where all other means have failed. This it does, not by cooling the burning mass, but by shutting off its supply of oxygen. It is possible in a mine often times to do this, since the few openings where the outer air can enter may be tightly sealed. After the combustion has ceased, water may be used to cool off the still glowing coal. But, as pointed out by Mr. C. J. H. WOODBURY in our issue of Jan. 11, carbonic acid gas cannot be used with similar effect in a building; and even if it could be so used, it would still require the application of water to cool the heated mass below the igniting temperature.

The Brooklyn Bridge Facilities.

The appointment by the Supreme Court last week of a commission to condemn the property in this city required for the enlargement of the carrying capacity of the Brooklyn Bridge is an important step in the direction of a sorely needed improvement Public interest will now naturally turn to the method which the Bridge authorities propose to adopt in bringing about the desired result. The plan agreed on is commonly known as the Martin-Barnes plan, as it bears the names of the engineer of the Bridge and one of the trustees. It consists, to put the matter briefly, of a double switching arrangement whereby trains will have to cross one another's path every 45 seconds, as it is intended to run them on that headway from the opposite sides of each of two platforms. It does not require the trained mind of the engineer to perceive that such a system involves a large element of danger, and we do not believe the traveling public will ever consent to the adoption of this plan when once it is clearly understood. The ENGINEERING NEWS has sounded a note of warning on the subject which ought not to be unheeded. It said in a recent issue:

It is at once evident that a train must pass over the crossing every 45 seconds, and that not at regular, but irregular intervals. . . . It is quite safe to say that no other crossing in the world has ever yet had such lively work over it, and as the crossing is situated on reversed 100-ft. radius curves, with crowded platforms within 50 ft. of it, on which panic may work terrible results in a few seconds, the dangers and disadvantages of such quick work over a crossing are intensified, not to speak of the added complications which will come from any attempt to switch the trains by cable.

The Board of Experts which reported on the question of traffic facilities for the bridge nearly two years ago was unanimous in its condemnation of any system like this. The board consisted of such eminent engineers as Messrs. WALTER KATTE, JULIUS W. ADAMS and JOSEPH CRAWFORD, and of course their deliberate judgment is entitled to the greatest weight. They laid special emphasis on the danger of grade crossings, and said: "We are therefore unanimous and most emphatic in the opinion that under no circumstances should such devices be employed upon the tracks of the bridge railway. They might, of course be employed safely for a long time, but experience unerringly points to the inevitable accident, which, sooner or later, is sure to occur." In the face of a verdict of such unimpeachable authority the bridge trustees have resolved upon the adoption of this plan, with all its attendant dangers and terrible possibilities.

It will be remembered that the experts referred to heartily recommended the adoption of the Wellington circulating system as the method best adapted for the development of the possibilities of the bridge to the utmost limit, with a total absence of danger. The trustees, however, decided against this, partly, at least, on the ground of its cost, and asserted that the plan which they chose in preference would "answer" until 1895, by which time it was estimated that the daily travel on the railroad would reach 228,000. Two years have passed since then and nothing has been done, and the indications are that nothing will be accomplished much before the expiration of the period named. The snail-like operations of the bridge authorities are thus vividly demonstrated, together with the likelihood that the crowding, jamming and jostling about the bridge will go on increasing almost indefinitely. It may be too late now to adopt the circulating system in its original form. [This is not the case, that plan in its original form not requiring much more land than it is proposed now to take, nor much more expense than it is proposed now to incur.—ED.] But it can never be too late to throw overboard a plan which involves great and constant dangers, and which, by the confession of its advocates, was at the best never more than a makeshift.—*New York Tribune.*

The Cubic Contents of Cement Barrels.

In our issue of Feb. 8 a correspondent puts a question concerning the cubic capacity of Portland cement barrels as placed on the market by various makers. The fact is that there is no fixed standard of size of barrel, and each manufacturer of cement makes a barrel that will hold a fixed quantity of his cement, as measured by the "struck bushel." And as cements vary much in weight, the barrels to hold this cement must be proportioned accordingly.

The query referred to has brought several replies, and giving these as sent us and tabulating them, we have the following for barrels of various brands:

Brand.	*Weight.*	*Bushels.*	*Cu. contents.*
Keene's Portland	400 lbs.	3½	(loose) 4.25 cu. ft.
Francis "			3.38 "
White Bros "			3.16 "
Johnstone "			3.38 "
Improved Anchor, Copley Co			3.32 "
Saylor's American Portland			2.85 "
Alsens, German Portland			3.33 "
Louisville, natural cement			3.75 "

A well known manufacturer of cement writes us that in this country cement is packed in barrels ranging from 15 to 18 in. in diameter at the head. Cement is also sold by the "barrel," but the weight may vary from 265 to 300 lbs. net per barrel. He says the Western cements, such as Louisville, Akron and Utica are sold at 280 lbs. gross, and 265 lbs. net per barrel; the Potomac cements at 300 lbs. gross, and 280 lbs. net, and the Rosendales of New York and Pennsylvania, the heaviest of natural cements, at 320 lbs. gross, and 300 lbs. net per barrel.

The size of the barrel, while generally larger for the lighter cements, may also be made so, owing to hand-packing and the absence of proper machinery for compressing the cement in the barrels. This is often the case in smaller works; and the same rule applies to the Portland cements, where a light-burned Portland, weighing 100 lbs. to the struck bushel, will require a larger barrel to give the consumer 380 lbs. net weight, than if a heavy-burned Portland were used weighing 118 lbs. to 125 lbs. per struck bushel. In the trade, 380 lbs. net constitutes a "barrel" of Portland cement.

Another correspondent, Mr. J. K. LLOYD, sends us a rule for measuring the contents of casks, which may be useful to some of our readers, and is given as follows: Add into one sum

39 times the square of bung diameter in inches.
25 " " " head " "
26 " " product of both these diameters in inches.

Multiply this sum by the total length of the cask in inches, and that product by .0000314 for the contents in gallons, and lastly by 277.27 for the contents in cubic inches. Thus, in a cask having a bung diameter of 32 ins.; head diameter of 24 ins. and a length of 40 ins.:

Bung	$32 \times 32 \times 39 =$	39,936
Head	$24 \times 24 \times 25 =$	14,400
Product	$32 \times 24 \times 26 =$	19,968
		74,304

$74{,}304 \times 40 = 2{,}972{,}160$

$2{,}972{,}160 \times .0000314 = 93.31$ galls.

277.27

25,872 cubic ins.

Foundations for Drop Presses.

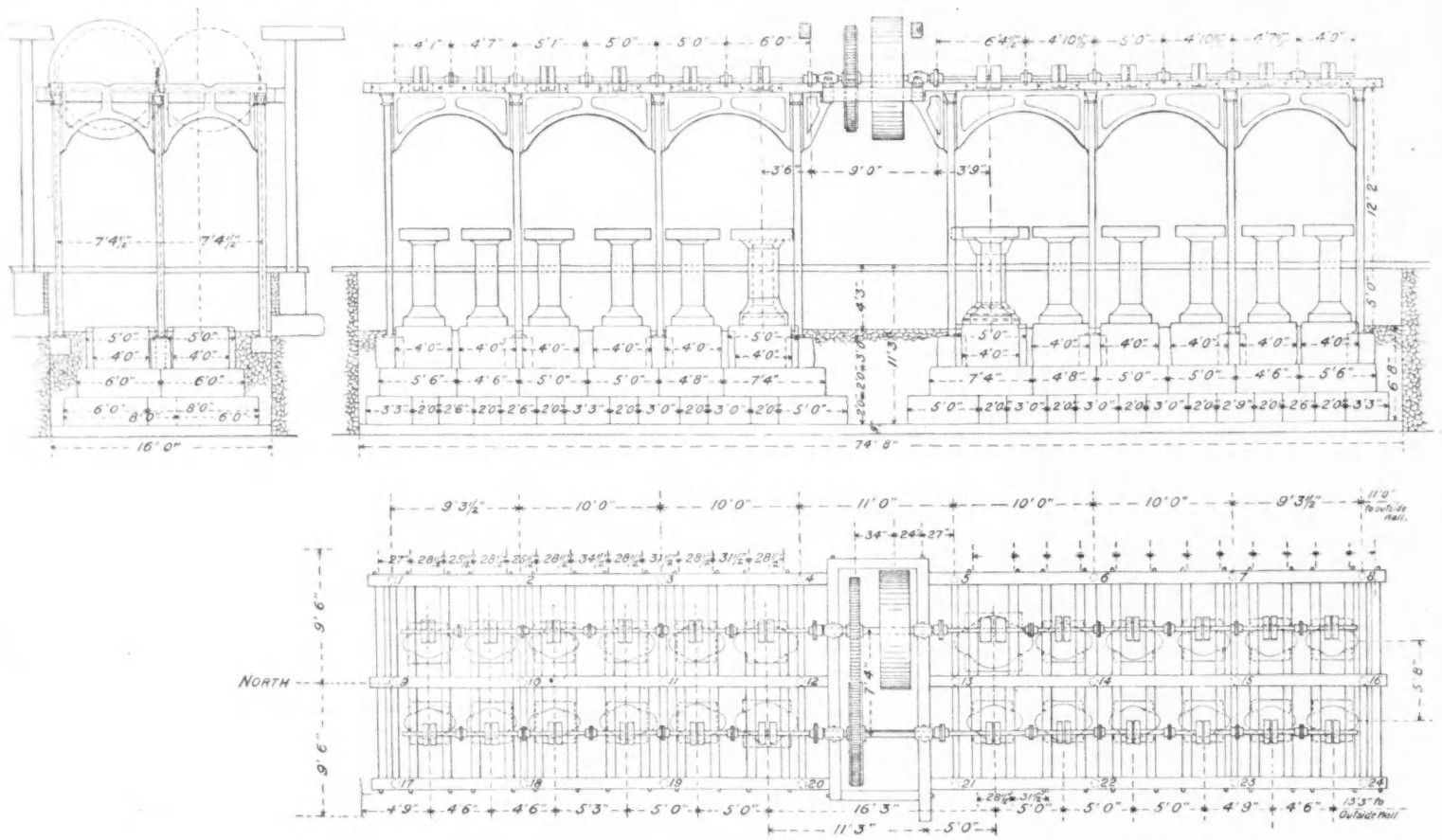
The new works of the Gorham Manufacturing Co., at Providence, R. I., cover nearly four acres of ground. The buildings are founded upon a firm bed of gravel. The works in full operation will employ from 1,500 to 2,000 men.

The drop-press department has demanded and received especial attention in this matter of foundations, and a short account of the methods pursued is now given. The work has been done under the direct supervision of Mr. JOHN M. BOGLE, the Master Mechanic of the Gorham Co., and the long expeperience gained in his connection with the old works has been here utilized in setting up the new presses.

This experience taught Mr. BOGLE that the foundations under these presses must be very solid and so bound together that no one foundation can yield under the forces applied to it. The drops themselves vary from 250 lbs. to 3,000 lbs. in weight and the fall varies from 2 ft. to 6 ft., according to the work required.

For this foundation a pit was first excavated 81 ft by 16 ft. and 12 ft. deep. As shown in the cut, large foundation stone were used, resting on a firm gravel foundation. Over the bottom of the pit a 10 in. bed of Portland cement concrete was laid, made in the proportions of one part cement, two parts sand and four parts of stone chips. The presses are set upon three courses of granite blocks of the dimensions given. The 102 blocks contain 4,872 cu. ft. of granite, supplied by the Smithfield Granite Co. It is an unusually strong stone, weighing 176 lbs. per cubic foot. The blocks were set in Portland cement, and the entire mass of masonry was imbedded in concrete.

The upper courses of the foundations are separated from each other and carry the iron bases of the presses, each weighing from 4 to 11 tons; on these the beds of the presses rest. The entire work is one of remarkable solidity, and no expense was spared to make the first cost the sole cost. We are indebted to Mr. OSCAR H. BRIGGS, the inspector in charge, for these details.



Drop Press Foundations at the Works of the Gorham Manufacturing Co., Providence, R, I.

Lacquer for Ships' Bottoms.

The Japanese newspapers, says *Engineering*, publish an official report by the captain of the Russian frigate *Dimitri Donskoi* on lacquer as a preservative of ships' bottoms. In the latter part of October, 1887, the frigate put into the Yokosuka Docks for the purpose of having her bottom examined and cleaned. After the water had been drawn off it was discovered that the entire steel line along her keel was so completely corroded that not a trace of paint could be discerned. The outer surface of the iron plates was found to be in a honeycombed condition, due to large numbers of shell fish, and this more particularly observable along the water line. Acting on the advice of some Japanese engineers, it was decided to adopt the lacquering process, which, although an invention of recent date, had already given satisfactory results. Not only the steel, but also the zinc portions were lacquered; its power of adhesion to this, however, was found to be very slight, and after the lapse of a month from the ship's departure from the dock the lacquer completely peeled off the zinc sheathing, and in six months the rate of speed of the frigate became perceptibly lessened.

In October, 1888, the frigate put into dock at Yokosuka a second time, and an examination revealed the fact that the lacquer on all the steel portion was in an extraordinarily good state of preservation, so much so that it could not be stripped off, except by being scraped with a sharp-pointed instrument. On scraping the foul part of the lacquer with a sharp instrument and removing all the varnish, the lacquer underneath was found to be still preserved in its original state and to be adhering strongly to the iron plates.

The results of this lacquering, as compared with that of the previous year, were highly satisfactory, and it is therefore not too much to claim that the great efficacy of lacquering to counteract corrosion has been conclusively established. From the experience thus gained it has been decided to substitute iron on the part where zinc had been used. Lacquering was first used on iron ships in Japan in 1885, after which the government decided on getting all the bottoms of their iron ships lacquered, so that up to this the experiment has been tried scores of times and the efficiency of the process tested over and over again. The virtues of lacquer for this purpose have long been recognized in Japan; but the above is stated to be the first report on the subject from a foreign naval expert.

The Smallest American Railway.

The most diminutive railroad in all Down East, according to a newspaper exchange, is that owned and operated by the Monson, Maine, Slate Co., running from the company's quarries to Monson Junction, on the Bangor & Piscataquis. This little road has a 2-ft. gauge, is about 6 miles in length, and is thoroughly equipped with locomotives, passenger, baggage and freight cars, has several stations, regular time-tables and a superintendent. The superintendent is also conductor, baggage-master, mail agent, passenger and freight brakeman, news agent and director —a regular Pooh Bah—and for performing all these offices he gets $900 a year. Ten men constitute the entire force of the road. The trains average about 50 miles a day in summer and 25 miles in winter. The road is all down hill one way, so that a car will run from the quarries to the junction without the assistance of a locomotive. If a passenger misses the regular train, $5 will secure a special to carry him over the line. Last year this toy road carried 9,000 tons of the company's freight to Monson Junction (6 tons to a car) for transhipment over the Bangor & Piscataquis to Bangor and points west, and 4,200 passengers, who paid $12,000 in fares, were transported at a cost of $9,000. This little road has been in operation 6 years, and in all that time no ac-

cident of any kind has occurred on its line. We judge it to be the smallest independent line running regular trains for both freight and passengers in America.

The Cape Fear & Yadkin Valley Railway.

The opening of the 84-mile extension of the Cape Fear & Yadkin Valley Ry. from Fayetteville to Wilmington, N. C., practically brings this important North Carolina road to a completion. The Cape Fear & Yadkin Valley R. R. Co. is the successor of the old Western R. R. Co. of North Carolina, chartered in 1852, and reorganized under the present name in 1879. The road, as projected, extends from Mt. Airy, N. C., to Wilmington, from Fayetteville, N. C., to Bennettsville, S. C., and branches to Madison and Deep River. In 1884 the line was opened from Greensboro, N. C., via Fayetteville to Bennettsville, S. C., including the South Carolina Pacific Ry. from the State line to Bennettsville. During 1886, 1887 and 1888 the line was extended to Mt. Airy, N. C., and the above named branches built. In March, 1888, surveys were commenced for the extension from Fayetteville to Wilmington, and by June 1 the contracts were all let and work was put in progress. Track-laying was commenced in May, 1889, and 62 miles of the road from Wilmington north had been completed Jan. 1, 1890. Since that date the remaining 22 miles have been finished and the extension opened. The road runs transversely across the State from northwest to southeast, passing through some of the finest agricultural and timber regions in the State, and connecting the mountains of southwestern Virginia and North Carolina with the seaboard. With the completion of the extension from Mt Airy to the Virginia State line to connect with an extension of the Cripple Creek division of the Norfolk and Western R. R., construction on which has already begun, a short line will be furnished from the coast to the mineral lands of southwestern Virginia. It is probable, also, that the line will be extended from Bennettsville to a connection with the Atlantic Coast Line System shortly. The completion of these two short lines will increase the through traffic of the road, now less than one-fourth of the total, by bringing the timber lands of North Carolina into more direct communication with the railway systems of the Central States, and affording an outlet for the mineral fields of Virginia and West Virginia to the seacoast at Wilmington.

The greater part of the engineering work attendant upon the construction of this and the other recent extensions of the road, was performed under the direction of Maj. ROGER P. ATKINSON, Chief Engineer. Mr. ATKINSON was Chief Engineer of the road for nearly three years previous to his death in last September, and the prompt and thorough manner in which these works have been carried out, was largely due to his energy and ability. The President of the company is JULIUS A. GRAY, of Greensboro, N. C.

The St. Clair Tunnel.

At the recent meeting of the Canadian Society of Civil Engineers, the President of the society, Col. GZOWSKI, in his address on engineering progress, described the St. Clair tunnel under the Detroit River. Though this journal has already given the main points concerning the plan of the works, the following summary under the latest methods of work is interesting:

The total length of the tunnel with approaches will be two miles and 1,145 ft. The length from face to face of the portals is 6,000 ft. The depth of open cutting at the east, Canadian side, of the tunnel is 62 ft.; at the west, United States end, 52 ft. The length of that part which is under water will be 2,310 ft., with a gradient to the west, rising one foot in one thousand. The greatest depth of the River St. Clair, on the line of the tunnel, is 40½ ft. The minimum thickness of the roof is 16 ft. The bottom of the tunnel is about 10 ft. above the rock underlying the clay. This has been ascertained by very accurate soundings and borings taken near the line of the tunnel at each 20 ft.

It may be well to say that a flow of gas was found immediately above the rock, indicating that its source was in or below that strata, the gas escaping through fissures in the rock. Locating the bottom of the tunnel above the rock, and yet securing sufficient thickness of material to support the roof, was in order to avoid meeting with gas. The material through which the tunnel is driven is clay, with pockets of wet sand and gravel.

The tunnel in cross section is circular, with an inside diameter of 19 ft. 10 in. It is a circular tube lined throughout with flanged plates of cast iron, 2 ins. thick, 5 ft. long, bolted together.

The ends of these plates are planed to make a close joint, and before being used they are heated and dipped in tar. The lower half of the lining is encased outside in 3 in. of grout, formed of the best Portland cement and coarse, sharp sand. Holes are made in the upper part of each plate, through which the grout is poured in. Under the river the whole of the outside of the cast-iron lining will be covered in this way.

In the prosecution of the work an iron shield is used under the protection of which the excavation is carried on, and the cast-iron lining is put together. The shield is just large enough to inclose the cast-iron lining, and as the excavation in front of it is advanced it is moved forward just far enough to put together one section of the tunnel lining. As the width of these sections or rings is only 18 in., and as the rear portion of the shield which incloses the lining overlaps it 39 in., the forward end of the lining is always within the shield. To insure safety as far as possible in the event of a sudden strong flow of quicksand or water, an iron diaphragm or bulkhead is built across the shield, 48 ins. from the rear of it, with two sliding doors which can at once be closed. The total length on both sides of the river of the completed tunnel to Jan. 22 is 2,006 ft.; in Canada, 844 ft.; in the United States, 1,162 ft. The time named for the completion of the tunnel is July, 1891.

THE PITTSBURG REDUCTION WORKS are making large additions to their Lawrenceville plant for producing aluminum. The new buildings will much increase the output of this material, for which new uses are being continually found.

STREET PAVING IN OMAHA.—Omaha began the work of paving in 1882, and since that time has laid 52½ miles of pavement as follows:

Colorado sandstone	9. 2 miles
Sioux Falls granite	4. 5 miles
Asphalt	11.25 miles
Cedar block. —	21 miles
Cypress block	5. 5 miles
Brick	1 mile

The total cost of paving up to date is $3,385,000, and it is the general opinion that the investment has added immensely to the permanent value of all the real property in the city.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York, Chicago & St. Louis.—The annual statement of this company for 1889 shows the following results from operations, as compared with the previous year:

	1889.	1888.
Gross earnings	$5,090,327	$4,918,205
Operating expenses	3,873,612	3,926,933
Net earnings	1,216,715	991,272

Chateaugay.—This company has purchased the right of way for the extension through the Adirondack Mountains from Saranac Lake to Lake Placid, a distance of about eight miles. The road is to be completed by July 1.

Pittsburg, Marion & Chicago.—The report that this company will extend its line from New Lisbon to Marion, 20 miles, is again in circulation.

New York & Northern.—A press report states that the directors of this company have approved the terms of a 50-year contract with the Hudson River Suspension Bridge Co., which is building a bridge at Peekskill, N. Y. The connection with the New York & New England R. R. will be made by building a short branch from some point in Westchester Co.

Wabash.—It is announced that this company has at last determined upon building the link from Chili to Peru, Ind., a distance of about 10 miles. The citizens of Peru have voted a subsidy of $45,000, raised by popular subscription $25,000, and donated 15 acres of land for terminal facilities. The line is expected to be completed by July 1.

Wilkesbarre & Scranton.—This road, which furnishes terminal facilities in Scranton, Pa., is being extended to meet the Ontario, Carbondale & Scranton R. R. now building from Forest City to Scranton, Pa.

Toledo, Findlay & Springfield.—Work is being pushed on the construction of this Ohio road. A large force of hands is engaged in laying track, and over a mile per day is being laid. Construction and freight trains are now running on the division from North Baltimore to Bowling Green, and the company expects to have trains running to Toledo, O., in a short time. The line south from North Baltimore to Findlay is being graded and is to be completed by May 1. The road when completed will be 120 miles long, passing through one of the richest portions of the State.

Easton & Northern.—A correspondent writes as follows concerning this enterprise:

Construction has been nearly completed on this road, with the exception of a 2,400 ft. tunnel and the bridge work. The road is 10 miles long, passing through a very rough country. The work is heavy, there being a large amount of heavy rock and earth excavation; maximum curve 14 degrees and average grade 20 ft. per mile. The principal business of the road will be in farm produce, passengers and the products from the quarries and factories along the route. James Smith, of Easton, Pa., has the contract for building the line. It is expected that the entire line, with the exception of the tunnel, will be completed by July. John S. Knight is President, and Peter Brady is Chief Engineer, both of Easton, Pa.

Central R. R. of New Jersey.—The annual report of this company for the year ending Dec. 31, 1889, shows the following results from operations:

Gross earnings	$13,497,394
Operating expenses	7,531,736
Net earnings	$5,965,658

Columbus, Lima & Milwaukee.—President Furot of this Ohio road is quoted as saying that the contract for the division between Lima and Columbus, O., would be let in 30 days, and the work pushed. The work on the big cut at Bellefontaine is nearly completed. The bridge work is all completed between Lima and Defiance, O., and tracklaying will begin in a short time. The road will be built from Defiance to Bryan, Mich., and north o Bryan to connect with the Mackinaw route.

Projects and Surveys.

Cochituate Branch.—This road is projected to run from the Central Massachusetts R. R., at Wayland, Mass. to Cochituate, a prosperous manufacturing village about 3 miles south. At a recent interview of a delegation of its citizens with the officials of the Boston & Maine R. R., it is understood that the latter parties made a proposition to build the road at once if the right of way was given them. The citizens of Cochituate are already taking active steps to secure this, and the present indications are that the scheme will be carried through. Henry A. Hancox, of Hudson, Mass., has been engaged to make the locating surveys, and has already commenced work.

Kettle Creek.—The incorporators of this Pennsylvania Railway Company noticed in our last issue are as follows: Jesse Munson, Bradford, N. Y.; Chas. R. Noyes, Westport, Pa.; Geo. R. Curtis, Meriden, Ct.: Edgar Munson, president: H. A. Merriman, R. H. Munson, C. L. Munson, David Bly and W. E. C. Merriman, all of Williamsport, Pa.

Cumberland & Washington.—It is stated that the construction of this road, noted in our last issue, will begin as soon as practicable after the bill providing for the lease of the Chesapeake & Ohio canal passes the Legislature. A preliminary survey of the proposed route has already been made, and the plans, in addition to the line from Cumberland, Md., to Washington, D. C., include a branch from a point on the canal bank below Point of Rocks, Montgomery County, Md., through Montgomery and Howard counties, crossing the Patapsco River at Ellicott City, and continuing to Baltimore, Md. It is not intended to construct this branch at present, however, providing satisfactory arrangements can be made with the Western Maryland R. R. for an entrance into Baltimore over its tracks. The line, if built, will prove a serious competitor with the Baltimore & Ohio R. R. for the coal traffic from the Cumberland coal regions. Asa Wilson, of Cumberland, Md., is one of the incorporators.

Sault Ste. Marie & Hudson Bay.—The bill to incorporate this company was taken up in the Dominion Parliament, Feb. 14. Sir John Macdonald spoke against the bill, saying that there were several parties asking for charters to build roads to Hudson Bay. Among them was the Winnipeg & Hudson Bay R. R. Co., and this scheme seemed to have something at its back and a good chance of obtaining sufficient capital for the construction of the line. The present project was in too embryonic a state to justify the killing or damage of the existing company by the granting of a new charter. The promotors of the road claim that the necessary capital has been promised, and that the prospects of the road being built at an early date are good.

Baltimore Belt.—We have received the following information from Samuel Rice, of 9 St. Paul St., Baltimore, Md., chief engineer:

The road is to run from a connection with the Baltimore & Ohio R. R. south of Camden Station, Baltimore, thence through the city to a connection with the B. & O. R. R. at Bay View Junction, a distance of seven miles. The route is through the city, the road passing over or under all streets. There is one tunnel one and a half miles long. The contract will be let as soon as the necessary municipal and other legislation is secured. Wm. Gilmor, of Baltimore, is President.

SOUTHERN.—Existing Roads.

South Atlantic & Ohio.—Tracklaying is being pushed on this road, and it is expected that the line will be completed to Big Stone Gap, Va., in a short time.

Seaboard Air Line.—Contracts are now being let for grading the Georgia, Carolina & Northern R. R. R. F. Hoke, of Raleigh, N. C., is President.

Chattanooga Southern.—The contract has been let for grading 25 miles of this road from Chattanooga, Tenn., to McLemore's Cove, Ga., and work is now in progress. This division passes through a rich timber and mineral region, and is to be completed in two months.

Louisville & Nashville—It is rumored that this company is considering the building of a short line into Atlanta, Ga. The scheme is to build a line from Stevenson, Ala., to a point on the Chattanooga Rome & Columbus R. R., about 25 miles north of Rome, Ga., thence following the

line of that road south, about 50 miles, and thence west to Atlanta. This route would give the L. & N. a line to Atlanta about 50 miles shorter than the present one from Atlanta to Stevenson.

Cape Fear & Yadkin Valley.—The tracklaying on the extension from Fayetteville to Wilmington, N. C., is now completed, and the line is ready for operation. Work has been commenced on the extension from Mt. Airy, N. C., to the Virginia State line, where connection is to be made with an extension of the Cripple Creek Division of the Norfolk & Western R. R. This extension, which is about 10 miles long, is to be completed in six months. About 10 miles of the factory branch have been completed, and the 9-mile extension is to be built as fast as possible.

Alabama Midland.—Only five miles of track now remain to be laid to complete this road from Bainbridge, Ga., to Montgomery, Ala.

Chattanooga, Rome & Columbus.—In regard to the scheme for the consolidation of this road with the Rome & Decatur R. R., and the proposed extensions of the consolidated company, which was described in our last issue, Mr. John D. Williamson is quoted as saying:

The bonds have been signed, and enough of them have been issued and sold to extend the Rome road from Kingston to a connection with the Marietta & North Georgia R. R. I do not mean by this to say that some one has merely subscribed for the bonds, but that they have been actually sold and delivered, and the money is in the treasury of the Rome R. R. Co., upon deposit with its financial agent in New York. We expect to have the road extended to Kingston to a connection with the Marietta & North Georgia R. R., and open for business during the year. I do not know the precise route the extension from Kingston will take until the engineers have made their report. The most probable line, however, will be from Kingston to Cartersville, or near Cartersville, and from there to Canton.

Union Point & White Plains.—The money has been raised to make the surveys for the proposed extension of this road from White Plains to Tennille, a distance of about 34 miles. John C. Hart, of Union Point, Ga., is President.

Gainesville, Jefferson & Southern.—It is reported that this road will be extended from Gainesville, Ga., to Athens, 17 miles.

Cincinnati Southern.—This company is reported to be negotiating for the purchase of the Nashville & Knoxville R. R. The road is now under construction from Buffalo Valley to Cookeville, Tenn., 22 miles, to be completed by April 1.

West Virginia & Pittsburg.—Arrangements are reported completed for the extension of the system of railways commonly known as the Camden system, connecting with the Monongahela River R. R., and the Baltimore & Ohio R. R., at Clarksburg, W. Va. The Monongahela River R. R. is now under construction from Shinnston, to Clarksburg, W. Va., 17 miles, and will be completed early in the season. The changing of gauge on the lines from Clarksburg to Weston, W. Va., and from Weston Buckhannon, W. Va., will be completed by June 1. It is expected to build the lines from Weston to Braxton C. H., W. Va., and from Buckhannon to the Gauley River during the present season. These lines comprise 175 miles of road and will connect the B. & O. R. R. with the central portion of West Virginia. The various companies building the lines have been consolidated into one corporate organization with the above name.

Black Diamond.—It is announced that the surveys for the Charleston Division of the Virginia, Parkersburg & Western R. R. will be continued from Charleston, W. Va., through Eastern Kentucky and via Cumberland Gap to Knoxville, Tenn. B. E. Cutler, of Zanesville, O., is Chief Engineer.

Norfolk & Western.—The preliminary annual statement of this company for the last fiscal year shows the following results from operations:

Gross earnings	$5,597,124
Operating expenses and taxes	3,483,352
Net earnings	$2,113,772

In a newspaper interview President Kimball is reported as saying that 16 miles of the extension of the Cripple Creek Division south to a connection with the Cape Fear and Yadkin Valley R. R. at the North Carolina State line are under construction, and surveys are now being made for the remaining 30 miles. It was also stated that work would begin on the line to Ironton, O., about March 1, and the road will be completed in 18 months.

Louisville Southern.—Work has been commenced on the division of the Richmond, Nicholasville, Irvine & Beattyville R. R., between Versailles and Nicholasville, Ky. P. Bruster & Co. has the contract from Garret Place to the Jessamine Co. line, and J. D. Leary from Versailles to Garrett Place. Both are pushing the work.

Projects and Surveys.

Norfolk & Richmond.—A bill has been introduced into the Virginia Legislature incorporating this company to build a line of railway from a point on the Elizabeth River near the city of Portsmouth through the counties lying on the southern and western banks of the James River to Richmond, and thence to some point on the West Virginia State line. Among the incorporators are Wm. H. Peters and J. T. Lawless, of Portsmouth, Va.

Albany, Florida & Northern.—This company has been formed in Georgia to build a railway from Albany to Cordele. Nelson Teft is President, W. S. Hawkins is Vice-President and W. E. Mitchell is Secretary and Treasurer. The preliminary surveys have been completed. The headquarters of the company are at Albany, Ga.

Bowling Green & Northern.—Contracts are reported let for the construction of this Kentucky road. H. P. Meyer, of Louisville, Ky., is the contractor.

Talbotton & Western.—Surveys will soon begin on this road, which is to run from Talbotton, Ga., west to a connection with the Georgia Midland R. R. and east to Prattsburg, Ga. The route is through a fertile portion of the country. Among the incorporators are W. A. Little, of Columbus, Ga.; J. H. Pitts, of Waverly Hall, Ga.; J. T. Parker, of Prattsburg, Ga.; and J. B. Gorman, of Talbotton.

Midland Transit.—Surveys are in progress on this road which is to run from Melrose to Rochelle, Fla., about 17 miles. Philip Prioleau is the engineer in charge of the surveys.

Columbus & Fulton.—A bill has been introduced into the Mississippi Legislature incorporating a railway company by this name.

Virginia.—Bills have passed the Virginia State Legislature incorporating the Appomattox, Buckingham & Cumberland R. R. Co., the Northwest & Southwest R. R. Co., the Appalachian Belt R. R. Co., and the Pittsburg, West Virginia & Potts Valley R. R. Co. The House has passed bills chartering the Broadway & West Virginia Ry. Co. and the Radford & Little River Ry. Co.

Kentucky.—Bills have been introduced into the Kentucky State Legislature, incorporating the North & South R. R. Co., of Louisville, the Fort Jefferson Belt R. R. Co., the Cumberland R. R. Co., and the Pinnacle Inclined Ry. Co.

Cumberland.—This company proposes to construct a railway from the line of either the Kentucky Central, the Cincinnati Southern, or the Louisville & Nashville railways in Kentucky, to the Tennessee State line.

Pinnacle Inclined.—The incorporators of this company are J. R. Young, R. G. Mitchell, J. E. Cooper, Harlan C. Turner, Wm. Sharp, M. A. Cockrell and R. H. Tomlinson, of Middlesborough, Ky.

North & South R. R. of Louisville.—This company proposes to build a railway along Ninth St. in Louisville, Ky., from its road canal to the southern boundary of the city, connecting with all the roads entering the city. P. G. Trunnell, of Louisville, is interested.

Burkesville & Northwestern.—Chartered in Kentucky to build a railway from Burkesville to a connection with the Louisville & Nashville R. R. at Horse Cave, a distance of about 40 miles.

Newcomb & Jellico.—Surveys have been made for a 3-mile road to connect Newcomb and Jellico, Tenn.

Paint Rock, Winchester & Memphis.—This road has been chartered in Tennessee to build a railway from Winchester, Tenn., south to a point on the Alabama State line, where connection will be made with the Gurley & Paint Rock Valley R. R. The officers are: Jno. W. Pattee, Cowan, Tenn., President; J. A. Custer, Vice-President; G. G. Phillips, Treasurer, and B. G. Slaughter, Secretary.

Tampa, Tallahassee & Western.—D. D. Rogers, of Ocala, Fla., Chief Engineer, has sent us the following data:

This company was chartered to build a line of railway from the city of Tampa to the city of Tallahassee, Fla., with branches from Ocala to Oldtown, and from Gainesville to Lake Butler. The length of the main line is 270 miles and the total length of the branches is about 85 miles. The main object of the line is to secure a short line from Chicago to Tampa. It passes through a portion of the State having no railway facilities, traversing the phosphate region and the best timber lands in the State. It is thought that the road will obtain a large traffic from the phosphate beds, which are stated to be of large extent and very rich. Connection is made with the Georgia Southern & Florida R. R. by the Gainesville & Lake Butler branch and a northern outlet secured. The timber lands along the route will cut from 5,000 ft. to 10,000 ft. per acre. These lands are now being opened up and will, it is expected, supply a large traffic. The officers of the company are: President, H. F. Dutton; Vice-President, O. J. Shipman; Treasurer, L. A. Burns; Secretary, J. S. McMillan; General Manager, Jas. M. Mayo, and Chief Engineer, D. D. Rogers.

NORTHWEST.—Existing Roads.

Northern Pacific.—The official statatement of this company for six months, ending Dec, 31, shows the following results from operations as compared with the same period of the previous year:

	1889.	1888.
Gross earnings	$12 655,365	$10,620,941
Operating expenses	6,780,515	6,263,916
Net earnings	5,874,840	4,357,025

The increase in net earnings for December, 1889, over those of December, 1888, was $170,113.

Projects and Surveys

Port Edwards, Centralia & Northern.—J. Edwards, of Port Edwards, Wis., sends us the following information concerning this enterprise:

The road is to run from Port Edwards, via Centralia and South Centralia, to Marshfield, a distance of about 30 miles. The route is through a timber region affording easy grades. The surveys are now in progress. The principal business of the road will be in timber and timber products, grain and flour. About one-third of the right of way has been secured. No local aid is asked, the projectors subscribing the money necessary to complete the road. The company hopes to be ready to let contracts before April 1 and to complete the road by Sept. 1. T. E. Nash, of Centralia, Wis., is president.

Alton, Venice & East St. Louis.—Surveys have been commenced on this road, which is projected to run from Alton to East St. Louis, Ill. Frank McCambridge, of Venice, Ill., is one of the incorporators.

Manitoba.—A press dispatch from Portage la Prairie, Man., says there are three notices of application to the Parliament of Canada for incorporation of railway companies, which, should they be built, mean material advancement to the Portage. The Portage la Prairie & Duck Mountain Ry. Co. desires power to construct a line of railway from a point at or near Portage northerly along the East of Riding Mountain to the Saskatchewan, with power to build a branch thence to connect with the Hudson Bay road; also a branch crossing the narrows of Lake Manitoba and connecting with the line of the said H. B. R. The Lake Manitoba Ry. & Canal Co. ask for authority to construct a line of railway from a point on the line of the present proposed railway, thence northwesterly to the waters of Lake Winnipeg. This company asks for power to build a branch from a point on the line of the proposed railway northwesterly between Lake Dauphin and Duck Mountain, and by Swan Lake to the Saskatchewan River.

SOUTHWEST.—Existing Roads.

Rockport, Langdon & Northern.—John D. Duff, of Rockport, Mo., Secretary, has furnished us with the following data:

The road is to run from Langdon, Mo., to Des Moines, Ia. Surveys have been completed for a distance of six miles north of Langdon, and this division only will be completed this year. The work is light; very little bridging and no tunneling. About two miles of the right of way has been secured. The contract for construction has been let to Haines Bros., of Castroville, Tex. It is expected that tracklaying will begin in June, and the road completed and opened for traffic by July or August. Robert Hunter is President of the company. The company was incorporated Dec. 28, 1889.

Topeka, Westmoreland & Marysville.—A correspondent writes us that work is about to commence on this Kansas road. Local aid, to the amount of $120,000, has been voted and the right of way through Topeka, Kan., has been secured, and a considerable amount along the route. Engineers will soon be put in the field to locate the line. The contract for the grading, bridging, masonry, and tracklaying on the first 55 miles of the road will be let about March 15. Robert Giles, of North Topeka, Kan., is Chief Engineer.

Cleveland, St. Louis & Kansas City.—The Farmers' Loan & Trust Co., of New York, has filed a petition for the appointment of a receiver for this company. This company is the successor of the Central Missouri R. R. Co., which was authorized to build a railroad from Kansas City, across the State, to a point on the Mississippi River, opposite Alton, Ill., with two branches. On June 1, 1887, an issue of 8,000 bonds, of $1,000 each, bearing three per cent. interest, payable semi-annually, and maturing June 1, 1897, was resolved on, and, subsequently, 250 of these bonds were sold. To secure them, the Farmers' Loan & Trust Company, as trustee, received a mortgage on all the property of the railway company. On March 28, 1888, the property of the Central Missouri was sold to the present company, and an arrangement was made with the holders of Central Missouri bonds, by which they were to exchange them for a Cleveland, St. Louis and Kansas City bond, issue of $7,000,000, made on April 2, 1888, the bonds bearing 5 per cent. interest and maturing Dec. 1, 1927. This arrangement was never consumated by the surrender and cancellation of the Central Missouri bonds, the Farmers' Loan & Trust Company contends, though the lien-holders' attorneys maintain that it was. The trust company declare that there was a default of interest last June and again last December, an assertion which the lien-holders deny.

Mississippi & Bonne Terre.—Grading on this road has been completed to Pevely, Mo.

New Orleans, Natchez & Ft. Scott.—It is announced that construction will begin from Rayville, La., north toward Bastrop, La., about March 1. An agreement has been entered into between the people of Bastrop and the construction company by which the latter is to commence work on this division of the line and push it to completion as rapidly as possible, on condition that the former donate $24,000 in aid of the enterprise. It is now expected that the line will be completed by July. W. Dunbar Jenkins, of Natchez, Miss., is Chief Engineer.

Projects and Surveys.

Gulf, Brazos Valley & Pacific.—This company has been chartered in Texas with the following officers: President, C. W. White; Vice-President and Treasurer, E. J. Gurley; Chief Engineer, Geo. B. Gurley; General Manager, W. H. Ross, and Secretary, H. M. Taylor. The general offices are at Waco. The railway is projected to penetrate the Texas bituminous coal fields. It is stated that the company will commence building in Palo Pinto County immediately, and will construct toward Waco and Seward, N. M.

Haines' Medina Valley.—At a meeting recently held, Mrs. Chas. D. Haines, the wife of one of the projectors was elected President. The company proposes to build railway from Lacoste to Castroville, Tex,

ROCKY MT. AND PACIFIC.—Existing Roads.

Utah Central.—A correspondent writes us that the Utah Western, Salt Lake & Fort Douglass and Salt Lake & Eastern rai'ways are to be consolidated under the above name in March. The Utah & Western is now graded from Salt Lake to Lake Shore, 20 miles. The other two lines are completed.

Half-Moon.—About one mile of this road has been completed at Pioche, Nev. The road is to be extended north seven miles. Sturges & Bryant, of Salt Lake City, are the engineers.

Vancouver, Klickitat & Yakima.—A construction party has been sent to the front and work will soon begin on this road. Charles Brown, of Vancouver, Wash., is Chief Engineer.

Denver, Texas & Ft. Worth.—Arrangements have been made by which this company will build 31 miles of railway connecting Trinidad and Denver and other points with the extensive timber and coal lands of the Maxwell grant. This new line, it is stated, is the beginning of a through line to Las Vegas, N. M.

Projects and Surveys.

Rio Grande Southern.—It is now announced that this road will be built in the near future. Contracts for the construction, it is stated, will be let about March 1. The road is projected to run from Dallas to Durango, Colo., a distance of 160 miles. Surveys have been completed from Dallas to Telluride, 43 miles. C. W. Gibbs, of Silverton, Colo., is Chief Engineer.

Spokane Eastern.—A railway company by this name has been chartered in Washington. Among the incorporators are: Chas. S. Dishman, John Johnston, Jno. R. Dabney and others.

Farmers' Transportation Co.—This company has been chartered in Washington to build a railway on the north side of the Columbia River from a point opposite Celilo to a point near Gig Eddy, thence via the Dalles to a point opposite Astoria, Oregon, with a branch from Celilo to Wallula. The principal office is at Vancouver, Wash. Among the incorporators are: H. D. Chapman, F. H. Taylor, S. T. Hidden, and others.

Great Falls & Canada.—Chief Engineer Barclay is reported as saying that this road is to be completed by Sept. 1, 1890. Surveys are now in progress, and work is to begin March 1.

FOREIGN.

Matamoras & Matehuala.—It is stated that this Mexican road will soon be under construction. The road runs from the city of Tamaulipas, via Villa de Mendiz, Cruillas, Burgos, San Nicolas, Villagrau, Hidalgo, Victoria and Linares to Matehuala. The country through which the road runs is rich in minerals and timber, and capable of producing large crops of cotton, sugar and tropical fruits.

Mexican.—Work on the Pachuca division of this road is being pushed. The line has reached a distance of 14 miles, of which 12 have been completed, with the exception of the masonry. A large amount of material is at hand and the work will progress without delay.

Mexican Central.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$6,337,226
Operating expenses	3,511,827
Net earnings	2,825,399

In regard to the Tampico division now under construction the report says that there are now less than 50 miles of track to be laid on the line. The line will not be completed until March 31, instead of March 1, as was expected, on account of the inability to secure material fast enough.

Guatemala.—A press report states that A. M. Bannister, the civil engineer who constructed the line of railroad from San José de Guatemala to Guatemala City in 1884, said he had received advices from Central America to the effect that that line is soon to be completed from Guatemala City to Port Barrios, near the mouth of the Meloqua River. This means that Guatemala is to have a railroad from ocean to ocean. The transhipment of freight across the country will save much time and distance in the route from New York to the western ports of South America. A steamship line from Tampa, Fla., to Port Barrios would shorten the distance still more. According to Mr. Bannister, the eighty miles already built cover the difficult parts of the work.

RAPID TRANSIT.

Cable Railways.—The Central Cable Ry. Co. has been incorporated at St. Louis, Mo., by A. E. Whipple, D. W. Edgerton and D. D. Hoag. Capital stock, $10,000.

The Baltimore Traction Co., of Baltimore, Md., will begin work shortly on the line between Druid and Patterson Parks. S. D. Smith & Son, of Philadelphia, are the contractors.

The North Beach & Mission Ry. Co., of San Francisco, Cal., will change its California St. line to a cable system.

Electric Railways.—At Lancaster, Pa., B. L. Stauffer and Johnson Miller are interested in a projected line to Lititz, 8 miles distant.

The Pittsburg Electric Ry. Co., of Pittsburg, Kan., has been incorporated by F. Playton, H. B. Wilson, and F. E. Doubleday, of Pittsburg; B. F. Hobart, of St. Louis, Mo., and A. E. Stillwell, of Kansas City. Capital stock, $50,000.

The Bennett Street Railway Co., of Whatcom, Wash., will apply for right of way for an electric road. Mr. H. Y. Thompson is interested.

Street Railways.—At Steubenville, O., the Market St. & Pleasant Heights St. Ry. Co. has been incorporated. Capital stock, $50,000.

The Cumberland St. Ry. Co., of Knoxville, Tenn., has been incorporated by W. H. Simmonds, Samuel Luthell and J. C. White.

At Columbus, Ga., surveys for a belt line of street railway have been made by Mr. Flournoy, C. E.

The Citizens' Street Ry. Co., of Peoria, Ill., has been incorporated by E. S. Easton, Martin Kingman and F. J. Miller. Capital stock, $250,000.

At Kokomo, Ind., a franchise has been awarded for a street railway 3 miles long.

The Chicago & Suburban Belt Line Passenger R. R. & Extension Street Ry. Co., has been incorporated by E. E. Harbert, Frank E. Barker and John A. Taylor. Capital stock, $2,500,000.

HIGHWAYS.

District of Columbia.—The following proposals for improving county roads have been received by the District Commissioners, Washington, D. C.: Bunker Hill road. M. F. Talty; 3,000 cu. yds grading at 20 cts.; 1,000 ft. of haul at ¾ ct.; 5,500 yds. of macadam at $1.10; 1,800 yds. of cobble stones at 35 cts.; 12 and 16-in. flags, 7 and 10 cts.; $2.70 per cu. yd. for broken stone, 35 cts. for cobble stones, 80 cts. per yd. for gravel. Total, $7,555 for work and $4,995.60 for material. Andrew Gleeson; grading 18 cts.; haul, 1 ct.; macadam, $1.25; cobble stone, 20 cts.; flag, 8 and 10 cts.; broken stone, $2; cobble stone, 12 cts.; gravel 74 cts. Total, $8,075 for work, $3,482 for material. W. H Mohler; grading, 21 cts.; haul, ¾ cts.; macadam, $1.24; cobble stone, 49 cts.; flag, 5 and 15 cts.; broken stone, $2.25; cobble stone, $1.75; gravel, 81 cts. Total, $8,643 for work, $6,831 for material. Canal road. Andrew Gleeson; grading, 18 cts.; haul, ¾ cts.; graveling macadam, 93¾ cts.; macadam, 37 cts.; cobble stone, 20 cts.; flagging, 8 and 12 cts.; broken stone, $1.90; cobble stone, $1.25; gravel, 79 cts.; Total, $8,660 for work, $6,842 for material. N. J. Foley; 30 cts. for grading, 1 ct. for haul, 25 cts. for graveling, 65 cts. for macadam, 40 cts. for cobble paving, $2.25 for broken stone, 40 cts. for cobble stone, $1.35 for gravel. Total, $1,700 for work, $10,148 for material.

Missouri.—A petition is to be circulated at Webster Groves for signatures to ask the County Court to macadamize Shady Ave. from the Collins road to the North and South road. It has been ascertained that the County Judges are favorable to the movement, and no time will be lost in securing the necessary signatures to put the matter in shape before the court, and secure for Webster a much-needed improvement.

Virginia.—A meeting of farmers was held at Eastville, Feb. 10. The most important matter discussed was the subject of county roads. It was decided to circulate petitions praying the State Legislature to pass for Northampton County the road-law, the principal features of which are the combination of the contract and labor systems. It is also proposed that the tax received from the railroad, which amounts to $800, be applied to the county roads. Captain Orris A. Brown, manager of Hollywood truck-farm, the largest in Virginia, William B. Wilson, George G. Savage, and others spoke in favor of these measures. The expense to the citizens of the county on account of bad roads was shown by comparing the ability of a double team to haul over the roads of Hollywood truck-farm, where the roads have been put in excellent condition, 55 barrels of produce, whereas, on the ordinary county roads, they can only haul 12 barrels. The principal cost of the road is the making, in the first instance, the maintenance, as reported by Captain Brown, being $5 per mile per annum. It was the universal sentiment of the meeting that the present road-law was suited to slave-labor, but is inadequate to the purposes of the present day.

New Jersey.—The township of Franklin opened bids on Feb. 14 for constructing 7 or 8 miles of 4-in. macadam road, 15 ft. wide. The specifications called for 2 ins. of broken trap-rock, to be rolled with a roller weighing at least 400 lbs. per inch of driving wheels, filled with trap screenings, so that "water will flush over the entire surface." The roadbed, graded by the town, is to be rolled with same roller to the satisfaction of the engineer. All earth used for making good the line and profile is to be measured in carts or wagons. Trap rock and screenings can be delivered at Franklin for from $1.75 to $2 per cubic yard. The bids were as follows:

	Macadam, per lin. ft.	Earth, per cu. yd.
McKeenan & Bergen, Paterson	99 cts.	30 cts.
Thos. Neven & Son, Orange	97½ cts.	30 cts
John A. Booney, Paterson	97 cts.	25 cts.
Wright & Lindsley, Orange	87 cts.	40 cts.
Bernard Mahon, New York	$1.25	Informal.

Mr. E. P. North, M. Am. Soc. C. E., the Consulting Engineer, says that, from the above bids, this 4-in. macadam will cost about $4,700 per mile, whereas Telford pavement in the same neighborhood costs $12,000 to $15,000 per mile. The contract has been awarded to Wright & Lindsley. The total amount will be about $50,000.

WATER-WORKS.

NEW ENGLAND.

Franklin, N. H.—A system of works is to be established. Legislative authority was granted to the town in July, 1889.

Lynn, Mass.—The Board of Aldermen has ordered $35,000 of water loan bonds issued.

Barre, Mass.—The question of water supply is being actively discussed.

Woonsocket, R. I.—About $17,000 will be expended this year for improvements.

Hartford, Conn.—The following quantities of cast-iron pipe will be laid this season: 1,712 ft. 4 in.; 43,985 ft. 6 in.; 2,822 ft. 8 in.; 4,500 ft. 20 ins. Repairs will also be made to the Farmington reservoir dam. The Board of Water Commissioners has also voted to take up $30,000 more of the water bonds.

MIDDLE.

Schenectady, N. Y.—The Water Commissioners have employed a well-driver to make tests for water along the bank of the Mohawk, opposite the city, between the Central railroad bridge and the Glenville bridge. Should the experiment prove successful it is proposed to sink enough wells to supply 3,000,000 galls. of water.

Hempstead, N. Y.—The Town Board and Highway Commissioners have granted the franchise of the town, outside of the villages of Hempstead and Far Rockaway, to the Lockwood Water-Works Co. They company is making an effort to secure a franchise for supplying Hempstead.

Syracuse, N. Y.—A new water bill has been introduced into the Legislature by Senator Hendricks. It provides for obtaining water from Skaneateles Lake, but restricts the dimensions of the pipe to 30 in. and prescribes that Syracuse shall, at its own expense and risk, raise the outlet dam so as to provide for storing all the water furnished by the watershed of the lake. It further provides that the dam and all structures connected therewith, together with the regulation at all times of the flow of water therefrom, shall remain under the exclusive control of a superintendent of public works.

New York, N. Y.—The Board of Public Works has recommended awarding the contract for furnishing materials, building and putting up a pumping engine, boilers, etc., at the Ninety-eighth St. station, to Henry R Worthington, of New York, at $54,700.

Plainfield, N. J.—The two engineers recently engaged by the city to ascertain the extent of Plainfield's natural water supply, have reported that it is doubtful if water can ever be obtained in sufficient quantities by boring. The contractor has been unable to secure water in sufficient quantities by this plan.

Camden, N J.—The Senate has passed Senator Pfeiffer's water bond bill, which allows Camden to issue bonds to the amount of $1,000,000 to extend the water privileges

Pittsburg, Pa.—A charter has been granted to the Citizens' Water Co. Captial, $1,000. The directors are Edwin E. Little, A. Marthens, Frank Wilcox, Chas. C. Wolff, and A. D. Updegraff.

Frostburg, Md.—A bill has passed the House empowering the town to acquire works.

Pittsburg, Pa.—A new company is proposed to supply water to the residents of the South Side. In the bottom of the Monongahela River, between Street's Run and Dam No. 1, there are a number of natural fountains sending forth pure spring water. It has been considered feasible to build around these springs so as to catch the supply and pump the water to a reservoir on the hilltop. James A. Chambers, I. L. Evans, W. C. Munhall, and others, are interested.

Cumberland, Md.—Councilmen Coulehan, Shriver, Zink, and Civil Engineer Gaffney, have been appointed by the City Council to investigate and examine the condition of the water that the city uses, and take soundings of the depth of the river above Lynn's wharf, and estimate the cost of a plan to secure pure water.

Bel Air, Md.—The Bel Air Water & Light Co. has been incorporated. The officers are O. S. Lee, President; G. R. Cairnes, Secretary; Richard Dallam, Treasurer. Capital stock, $50,000.

SOUTHERN.

Graham, Va.—It is reported that the Graham Land & Improvement Co. will construct a system of works. Also that pumping engines and other supplies are wanted.

Troy, Ala.—The Troy Water-Works Supply Co. has been chartered. The capital stock is $75,000. Work is to be commenced within two weeks.

West Knoxville, Tenn.—The town has voted to contract with the Woltmann Water Co., for a water supply. By the terms of the ordinance just passed the town agrees to take 40 hydrants now, and increase the number to 57 within 5 years. The company must lay 5 miles of mains in the city, commence work within 60 days and complete the system within 12 months. The company agrees to supply water to all public school houses and other public buildings free, and also free for an ornamental fountain in Circle park, and two public drinking fountains. The supply will be taken from Fountain Head or Sharp Gap Springs.

Greeneville, Tenn.—Address the Mayor for information regarding the projected works. The proposed source of supply is Horse Creek. Estimated cost, $25,000 to $35,000.

Memphis, Tenn.—The Cook Well Co., of St. Louis, Mo., has been awarded a contract by the Artesian Well Co. to sink four additional wells. They have already sunk 18 wells for this company, which have a daily capacity of 12,000,000 galls.

NORTH CENTRAL.

Miamisburg, O.—A. C. Schell, Clerk, informs us that no works will be put in at present.

Plain City, O.—A bill has passed the House in the State Legislature authorizing the Village Council to issue bonds for providing a system of works.

Charlotte, Mich.—The town has cast a majority vote of 448 in favor of issuing $25,000 of bonds for constructing works.

Evarts, Mich.—The new works have been completed. Cost, $11,000. Contractor, M. Walker.

Imlay City, Mich.—The citizens expect to vote upon the question of bonding the village to secure a system of works and electric lights at the coming spring election.

Harlem, River Forest, Maywood and Melrose, Ill.—The leading citizens of the township of Proviso have organized a stock company to introduce a complete system of water-works and an electric light plant to supply these towns. The capital stock is being rapidly taken up, and within a year the works will be ready for business.

Venice, Ill.—A proposition of East St. Louis to purchase the village works at twice the actual cost of construction is reported to have been made made by East St. Louis. It is stated that East St. Louis is compelled to remove its present works on account of the drainage from the National Stock Yards and of the glucose works recently erected here. The points selected for the East St. Louis pumping station tower and settling basins is about one-half mile north of Venice and near the east pier of Merchants Bridge. The erection of the plant and buildings and the laying of the water mains will cost several hundred thousand dollars. A bond is offered to indemnify the village for any damage caused, and no other favors or franchises are asked, except the right to construct mains through the streets. It is possible Belleville will eventually be supplied with water from this point.

Galesburg, Ill.—By a recent decision of Judge Gresham, affirmed by the U. S. Supreme Court, the franchise of the company has been rendered void, and the city granted authority to conduct its own work. Sources of supply are being investigated, and it is probable that the city will have a system of works in operation, and under its own control, within one year. J. C. Stevens is City Clerk.

Sparta, Wis.—At the coming spring election the voters will pass upon a proposition made by Minneapolis and St. Paul parties to provide works at a cost of $50,000, the city to pay an annual rental of $3,000.

Rice Lake, Wis.—The Rice Lake Water-Works Co. has been incorporated at Madison with a capital stock of $30,000. The incorporators are W. K. Coffin, M. W. Harris and W. H. Willard.

Burlington, Wis.—The following bids have been received for constructing works:

George C. Morgan, Chicago, Ill., $20,711; G. N. Sturtevant, Jr., Minneapolis, Minn., $21,745; Rockford Construction Co., Rockford, Ill., $20,810; Racine Construction Co., Racine, Wis., $21,160; O. C. Davis, Racine, Wis., $22,773; Wilson & Thatcher, Chicago, Ill., $21,200; United States Wind Engine & Pump Co., Batavia, Ill., $24,200.

Delaware, Wis.—Bids for constructing works have been received from J. B. Reader & Co., Delavan, and C. E. Gray, Jr., & Co., of White Water, Wis. Each bid specified 3 miles of mains, with 30 to 36 fire hydrants, respectively. Free water for all public buildings, 1 display fountain, 2 watering troughs. Reservoirs to contain 65,000 to 100,000 U. S. galls. and to cost an annual rental of $1,800 to $1,950. Franchise to hold for 25 years in each case, with options to purchase at the end of each 5 years.

NORTHWESTERN.

Marshalltown, Ia.—H. Madsen, Chief Engineer, informs us that the city has contracted with the Gordon Steam Pump Co., of Hamilton, O., for a compound condensing pumping engine having a daily capacity of 2,000,000 galls.

Creston, Ia.—The City Council has granted a franchise to Reagan Bros., of Omaha, Neb., placing the firm under $15,000 bonds, to construct works this spring.

Topeka, Kan.—Judge Foster has granted a temporary restraining order against Job Mulvane, President of the Topeka Water Co., restraining him from selling the stock of the company to Coffin & Stanton, of New York, and Woodbury & Moulton, of Portland, Me., for $550,000. The plaintiffs, Westcott & Hansen, allege a previous contract had been made by which Mr. Mulvane agreed to sell the stock to them for $50,000 less.

Woonsocket, So. Dak.—The fire protection system is being remodelled and perfected. The water supply will be furnished by the new artesian well.

Wymore and Minden, Neb.—Works are being constructed.

O'Neil, Neb.—Frank Campbell writes: "Our bonds did not carry, so we are not ready to contract."

Tyndall, So. Dak.—City Auditor H. B. Phenix informs us that the new works have been completed. Cost, $7,000.

Oakes, No. Dak.—Work was begun in November, 1889, and is to be completed in April, 1890. The necessary valves, hydrants, etc., have not been purchased. There will be two miles of mains. The supply will be taken from an artesian well. W. P. Butler is the Designing Engineer.

New Castle, Wyo.—A company has been organized to supply the town with water. The capital stock is $100,000.

SOUTHWESTERN.

Neosho, Mo.—A proposition to construct works has been made to the town by Nevada, Mo., capitalists. The question will be decided by a citizens' vote.

Fayetteville, Ark.—It is reported that a Muscatine, Ia., party has proposed organizing a company to establish works.

Batesville, Ark.—The following information is from J. N. Reed:

No contracts for machinery, supplies, or construction work have been let. Wells are now being bored. Water will be pumped from wells to a reservoir. The city will pay the Batesville Water Co. $40 per year per hydrant. J. N. Reed, President; Jas. Landon, Secretary; Simon Adler, Treasurer. No engineer has been engaged as yet. Population 3,000.

A later press report states that the home company will probably not build the works; and that for a reasonable sum to cover their expenditure the company will relinquish its franchise. John W. Hamilton, of Arkansas City, Kas., proposes to put in a system of works and electric lights; it is expected that his proposal will be accepted.

Luling, Tex.—The mayor has been petitioned by a large number of business men to call a meeting of the citizens to consider the proposition to erect works.

Bonham, Tex.—Mr. James K. Blair has sent us the following:

The artesian well proved a failure. Another contract has been let for sinking a well in another part of the town, upon which work is soon to be commenced.

Abilene, Tex.—A stock company will probably be organized to purchase or lease the present works and enlarge them. Artesian wells are to be sunk and a new reservoir constructed. Address O. W. Steffens.

Guthrie, Ind. Ter.—Mayor James Dooley has sent us the following information:

The City Council is entertaining several propositions to build large and extensive works. The present system consists of about 3½ miles of 4 in. pipe, and a Dean pump which forces water from the river to a tank, elevated about 40 ft. Water is used for street sprinkling and fire protection.

Colorado Springs, Col.—S. T. Wicks, contractor for the new works, informs us that they will be put in operation about April 15. The estimated cost is $19,000, procured by bonds.

New Castle, Col.—A. Bondurant, Jr., Town Recorder, sends us the following:

The works have not been started. Bonds have not been sold, but the town is still open for bids.

Denver, Col.—The Board of Supervisors has passed the ordinance, recently presented to the city by the Denver Water Co., authorizing the city to contract with said company for a term of 20 years from 1891. The measure is strenuously opposed by the Chamber of Commerce, and a resolution has been adopted requesting the mayor to veto it.

Pueblo, Col.—It is reported that an offer has been made to the South Pueblo Water Co. for the purchase of its entire plant. The company has the exclusive franchise for supplying water to Bessemer and to that portion of the City of Pueblo south of the Arkansas, and is rapidly increasing the territory covered by its pipes.

Green Mountain Falls, Col.—It is reported that a contract has been let for constructing a $20,000 system of works. They are to be completed in June.

PACIFIC.

Centralia, Wash.—Landrum & Landrum send us the following:

Construction will be begun within 60 days. Water will be pumped to a reservoir. A. J. Miller is President of the water company.

Port Townsend, Wash.—Engineer R. E. Andrews informs us that he has submitted preliminary maps, profiles and estimates for the Mt. Olympus Water Works Co. to the Board of Directors.

An 18-in. iron or steel conduit will be used for the main, 22 miles long. A 7,500,000-gall. reservoir will be built on Morgan's Hills, 300 ft. above tide-water. The final surveys will be commenced about April 1st. The works will be completed this year.

Santa Ana, Cal.—E. D. Cooke, informs us that propositions for constructing works are under consideration.

Selma, Cal.—J. W. Givens, Superintendent, informs us that a new tank and tower have been completed. Also that other improvements are contemplated. The officers of the Selma Water Co. are: President, D. S. Snodgrass; Secretary, Frank Couch.

Oakland, Cal.—In a recent interview with reference to the settling and distributing reservoir of the Contra Costa Water Co., to be constructed near Fruitvale, W. F. Boardman, the Engineer, stated that work will be commenced within a few weeks. The plans and estimates have been made. The reservoir will cover 14 acres and hold 90,000,000 galls. The reservoir will be so situated as to be free from the draining of the adjacent watershed. A concrete-lined conduit or channel will encircle the top of the reservoir into which the water will flow. At regular intervals openings in the channel will permit the water to flow out down the sides of the reservoir. This will ærate and purify the water.

Corinne, Utah.—The town will probably be supplied with water by the Bear Lake & River Water-Works and Irrigation Co. Nothing definite has yet been done.

ARTESIAN WELLS.

Faulkton, Dak.—The well has reached a depth of 1,000 ft.

Vilas, Ia.—A well is to be sunk.

Vicksburg, Miss.—H. F. Cook has been awarded the contract for boring the artesian well in the L., N. O. & T. yards.

IRRIGATION.

Bottineau, No. Dak.—Arrangements are being made for a convention to consider the subject of irrigation. The plan is to secure a special appropriation, and determine the practicability of utilizing the lakes and springs in the Turtle Mountains.

Santa Fé, N. M.—H. H. Armstead, Manager of the Rio Grande Valley Water Co., has stated that his company contemplates furnishing water for washing out the San Pedro and Golden placer beds along the Arroyo Tuerto, as well as supplying the mesa lands east of Lamy with water for farming purposes. The pipe line is to be supplied from the upper Pecos, and will pass down by way of Glorieta to the valley of the Galisteo. About 200 men and 30 teams are at present engaged in the work. The greater part of the work now being done is in excavating a ditch to connect the Golden pipe line, which the company owns, with the rich placer fields along the Tuerto, where the company owns about 11,000 acres of placer ground. About 300,000 acres of land will be reclaimed by this scheme.

Fresno, Cal.—The freeholders have presented a petition to the Board of Supervisors for organizing the Fresno Irrigation District under the Wright law. The petition will come before the board for hearing on March 3.

CANADA.

Wolfville, N. S.—Works to cost $25,000 are being constructed by the town. Work was commenced in Oct., 1889, and is to be completed in June 1890. The Water Commissioners are Fred Brown, Chairman; G. V. Rand and D. A. Munro. The contractors are Levi, George and J. Brown.

Deloraine, Manitoba.—The artesian well has reached a depth of 1,340 ft.

PROJECTS.

Works are projected in the following places: Rising City, Neb.—Sarcoxie, Mo.—Terryville, Conn., address R. Baldwin or Dr. W. P. Sweet.—South Pittsburg, Tenn., address the Deptford Land & Improvement Co.—Luling, Tex.

Ipswich, Mass.—Girard, Ill.—Miles City., Mont.—Dillon, Mont. Address, D. T. Chapman.—Maynard, Mass.—Woodstown, N. J.—Elkton, Md.—Blue Lakes, Cal. Address, David Powers.—Pulasks, Va. Address, L. S. Chaffee.—Port Arthur, Ont.—Plainsville, Conn.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—***Bothwell, Ont.***—W. E. McGeorge, County Engineer, Kent, Ont., will receive bids until March 5 for the construction of an iron bridge with two stone abutments across the river Thames on the county line between the counties of Kent, Elgin and Middlesex.

Brockville, Ont.—R. D. Hervey, of Brockville, Ont., has prepared plans and specifications for the bridge to be built by the Thousand Islands Bridge & Ry. Co. before mentioned.

Montreal, P. Q.—The bridge which a number of local gentlemen are applying for a charter of incorporation to enable them to construct over the St. Lawrence it is intended shall be a double one, equally suitable for railway and general traffic. It will cross the river over Isle Ronde, and there will be but one span from that spot to the city shore. So that navigation may not be interfered with the bridge will be one hundred and fifty feet above high water.

Syracuse, N. Y.—A bill is before the New York State Legislature appropriating $13,000 for the construction of a bridge across the canal at Geddes St. in this city.

Baltimore, Md.—A resolution has been introduced in the City Council directing the City Commissioner to prepare plans and estimates for bridging Monroe St. over the Western Maryland and Baltimore & Potomac railways.

Florence, Ala.—The County Commissioners have let the contract for the Gunwale Ford bridge, adjoining the city, to W. H. Converse, of Chattanooga, for $1,078. There were sixteen different contractors bidding on the work. The bridge is to be an iron structure 250 ft. long. The contract calls for the completion of the work by June 13.

Natchez, Miss.—The Chief of Engineers has made a supplemental report on the Natchez Bridge bill, recommending that the proposed extension of time for the completion of the bridge be granted. The bill will be reported favorably.

Greenville, Miss.—Bids for the construction of a bridge across Lake Robinson are being received by C. M. Johnson of this place.

Couchville, Conn.—Bids are being received for the construction of the bridge across Silver River at this place before mentioned. Address Jas. Engles, 1 and 2 Colonnade Building, Nashville, Tenn.

Hadley, Ky.—The following bids for an iron superstructure for a bridge across Gasper River at Hadley

Ky., have been received: The Queen City Bridge & Steam Forging Co., Cincinnati, $3,177; the Youngstown Bridge & Iron Works, Nashville, $3,100; the Lane Bridge & Iron Works, Chicago (6 span plan), $2,999; on a seven panel plan, $3,400; the Champion Bridge Co., Wilmington, O., $2,990; the Milwaukee, Wis., Iron Works, span complete, $3,240; taking down and piling old bridge, $250; the Wrought Iron Bridge Co., Canton, O., $3,050; the Variety Iron Works Co., Cleveland, O., $2,980; the Penn Bridge Co, Beaver Falls, Pa., $3,590; the Mt. Vernon Bridge Co., Mt. Vernon, O., $3,050; the Smith Bridge Co., Toledo, O., $3,124; the King Iron Bridge Manufacturing Co., Cleveland, O., $2,950; the F. J. P. Bracket Bridge Co., Cincinnati, O., $3,600; the Massillon Bridge Co., Massillon, O., $2,075, and the Columbus Bridge Co, Columbus, O., $3,400. All bids were rejected and new proposals called for.

Omaha, Neb.—The new plans for the railway bridge at this city, now submitted to the Secretary of War, provide for a high double track bridge 2,000 ft. long, divided into three spans of 400 ft. each, two of 250 each and two of 150 each. The latest information about them from Washington is favorable to their approval.

Nebraska City, Neb.—The City Council has formally accepted the act of Congress authorizing the building of a bridge at this city. J. A. L. Waddell, who has prepared plans for a bridge, was authorized to represent the city at Washington, and will leave immediately to lay the plans before the Secretary of War.

Houston, Tex.—It is stated that three new bridges 80 ft., 100 ft and 70 ft. long, respectively, will be built over Hull's, Green's, and German bayous. Address J. B. Perkins, Houston.

Helena, Mont.—Bids are invited for the construction of a bridge over Dearborn Canal at the crossing of the Augusta & Dearborn Cañon road. Address J. S. Tooker, County Clerk, Helena.

Proposed.—Bridges are proposed at Fredericksburg, Va.; Lynchburg, Va.; Atlanta, Ga., and Ft. Smith, Ark.

Canals.—The Brazos, Union Bayou & Bernard Canal Co., of Quintana and Houston, Tex., has been incorporated by E. M. House, Z. T. Fulmore, W. B. McLaughlin and others to build a canal from East Union Bayou to the Bernard River, which is to be made navigable. Capital stock, $10,000.

It is rumored that a syndicate contemplates the construction of a canal from St. Mark's, Fla., to the Atlantic coast.

It is proposed to organize a $100,000 stock company to drain the Grindle Creek section by cutting a canal. For particulars address J. B. Little.

The Norfolk & North Carolina Canal Co., of Norfolk, Va., has increased its capital stock.

SEWERAGE AND MUNICIPAL.

Sewerage.—Nashville, Tenn., has 24.02 miles of sewers, 16.81 miles having been built since 1884, at an annual cost of about $25,000. The city budget for this year includes an appropriation of $75,000 for sewers.

A new sewer is to be built at St. Johnland, L. I., at a cost of $3,000. James F. Carey prepared the plans and specifications, and they provide for 500 ft. of 6 in. pipe, 300 ft. of 9 in., 1,150 ft. of 12 in., and 575 ft. of 15 in.

At Knoxville, Tenn., a resolution has been introduced to the effect that an election be held May 3 for the purpose of issuing bonds for the construction of a sewerage system, according to authority given by the Legislature on May 14, 1887. The resolution was followed by an ordinance constituting John S. Van Gilder, W. W. Woodruff, James W. Cooley, S. H. Middleton, W. T. White, Matthew McClung and John Dempster a sewerage committee. The ordinance gave the commissioners full authority to engage a competent civil engineer to make surveys and estimates as to the cost of a sewerage system for Knoxville. In connection with the Board of Public Works the Commissioners were to have charge of the letting of contracts, the disbursements of moneys, and all other matters pertaining to the construction of a sewerage system.

The Board of Street and Water Commissioners of Jersey City, N. J., have decided to build a new sewer in the Third District that will empty into the Hudson River. That locality has long needed a sewer. The cost of the work will be about $50,000.

At Laredo, Tex., the City Council has authorized the employment of an engineer to lay out a system of sewerage.

At Rome, Ga., the construction of sewers is projected. They will be of brick, supplied by the Rome Brick Co.

At Portsmouth, Va., the Portsmouth Sewerage Co. will construct sewers at a cost of about $10,000.

The contract for about 20 miles of sewers at Fort Worth, Tex., has been awarded to Allen & Veith, of St. Louis, Mo., at $119,000.

At Columbus, O., an ordinance has been passed to issue $330,000 in bonds for the intercepting sewer.

At London, Ont., the City Engineer has been directed to prepare a plan and estimate of the cost of a trunk sewer down the course of Carling Creek large enough to carry off all storm water and sewage matter; also as to the cost of a tile sewer down the course of the same.

At Denver, Col., City Engineer McIntyre has submitted to the Board of Public Works the following estimate of cost of the main sewer in Wazee, Wynkoop, and Wewatta Sts., extended from 11th St. to a point 300 ft. northeast of the centre line of 31st St.:

Brick, 3,280,600, at $22	$72,173 20
12,700 cu. yds. rubble concrete backing, at $7.50	95,250 00
61,200 cu. yds. excavation, at 35 cts.	21,420 00
38,700 cu. yds. embankment, at 25 cts.	9,675 00
3,000 cu. yds. slag protection, at $1	3,000 00
370 cu. yds. broken stone sub drain, at $2.50	925 00
27 manholes, at $70	1,890 00
5 receiving basins, at $125	625 00
5 connections, storm sewers	1,350 00
Protection and gates at outlet	3,000 00
Pumping 300 days, at $7.50	2,250 00
	$211,558 20
Engineering superintendence and contingencies	13,222 38
Total estimate	$224,780 58

Street Work.—At Chattanooga, Tenn., it is proposed to lay brick paving on Whiteside St., at a cost of $45,000. For particulars address F. J. Bennett.

At Hot Springs, Ark., plans have been prepared for street improvement. For particulars address the mayor.

The Board of Finance, Albany, N. Y., has decided to issue street improvement bonds for $71,845.

ELECTRICAL.

Electric Lighting.—In the Board of Aldermen at Boston, Mass., on Feb. 10, the petition of the Suburban Light & Power Co. for leave to erect poles in Roxbury and Dorchester was refused by a vote of 5 to 7. This is the company which was recently awarded the contract by Mayor Hart for furnishing electric lights for certain sections of the city, and it has been opposed by the Boston Electric Light Co., which held the contract last year. If the company may not erect poles in Roxbury, West Roxbury and Dorchester, which they may not do now, they cannot furnish lights to the city, as they proposed to do, at 39cts. and a fraction per lamp per night. When the city of Boston advertised last year for electric lights, specifying that no bids above 40cts. would be considered, the Boston Electric Light Co. announced that it could not furnish lights at that price, but the Suburban Light & Power Co. made a bid of between 39 and 40 cts. The Boston Electric Light Co. will take the contract at 40cts.

At Rockville, Conn., a contract has been made with the local gas company to light the streets with 74 electric lights of 1,200 c. p., at $75 per light per year. The lights are to burn 300 nights.

The Village Trustees, Herkimer, N. Y., have unanimously adopted a resolution granting to the Thomson-Houston Electric Light Co., of Boston, the right to erect poles and string wires in the streets to provide electric light. Work must be commenced within sixty days, and the village will not pay more than $75 a year for arc lights of 1,200 c. p., and $17 a year for incandescent lamps of 32 c. p. The resolution also provides for proper insulation of wires.

The town of Shelby, N. C., has voted to issue $1,800 in bonds for electric light.

The United Edison Electric Light Co. has the contract for an incandescent plant at Cordele, Ga.

At Detroit, Mich., a committee has been appointed to review the electric lighting contract with the Detroit Electric Light & Power Co. The mayor did not approve the ordinance. For the present system of 712 lamps the Detroit Co. bid $98,541; the Brush Co., $107,854. For providing underground wires, 827 lamps, the Detroit Co. bid $115,815; the Brush Co. made no bid.

The Lamp Committee of Buffalo, N. Y., has directed the comptroller to advertise for new bids for electric lighting.

CONTRACTING.

Fog Signals.—The following proposals for 7 sets of steam fog signals were opened Feb. 15, at the office of the U. S. Lighthouse Engineer, Detroit, Mich: Variety Iron Works Co., Cleveland, O., $17,454; Galvin Valve & Hydrant Co., Detroit, $17,900; Thomas Manning, Jr. & Co., Cleveland, $18,240; Frontier Iron & Brass Works, Detroit, $19,300; Russel Wheel & Foundry Co., Detroit, $19,865; John Cooper, Mt. Vernon, O., $21,840; S. I. Pope & Co., Chicago, $24,729; Parish Mfg. Co., Ashland, Wis., $29,467; Robert J. Gray, New York City, $16,280 for 4 sets.

Sewer and Street Work.—At Huron, O., the contract for sewer has been awarded by T. H. Derry to McKean & Callan, of Sandusky, O., at the following prices: 15 cts. per ft. for 2,800 ft. of trenching; 16⅔, 21 and 30 cts. per ft. for 10, 12 and 15-in. pipe; $7.56, $12.96 and $10.80 for 10, 12 and 15-in. branch pipe; $11 and $15 for catch basins; $10 and $27 for manholes; total, $1,639.96.——The bids for street work were as follows: Stone & Scott, Toledo, 20 cts. per cu. yd. for 5,000 cu. yds. of excavating and grading; $1.35 per cu. yd. for 3,750 cu. yds. of macadamizing; total, $6,062.25; Carl Schneider, Sandusky, 15 cts., $1.23½, $5,393.75; D. Hoffman, Sandusky, 20 cts., $1.20, $5,500; B. Sullivan, Fremont, 18 cts., $1.66, $7.125; Jas. Conly, Sandusky, 13 cts., $1.12, $4,850; McKean & Callan, Sandusky, 12¼ cts., $1.24, $5,362.50. The contract was awarded to J. S. Conly.

Dam.—The following table gives the contract prices for the dam in the Missouri River at Great Falls, Mont. The dam and head gates will be 1,100 ft. in length and will require the placing of approximately 1,600,000 ft. of timber, 60,000 ft. of plank, 100 tons of iron work and bolts, 8,000 cu. yds. of stone filling in the cribs, 3,000 cu. yds. of gate chamber masonry and 12 head gates. Mr. J. F. Fanning, M. Am. Soc. C. E., of St. Paul, Minn., is the Consulting Engineer. The contract has been awarded to Fred Whiteside, of Helena, Mont. The lumber, iron work and cement are furnished to the contractor. It is stated that the water power obtained for manufacturing purposes will be about 30,000 H. P.

Work.	Quantities.	Accepted bid for Labor.	Range of Bids for Labor.
Excavat'n of solid rock for gate chamber	9,000 cu. yds.	$1.18	$1.18 to $4.20
Excavation of solid rock for bedding timber	50 " "	1.45	1.45 " 5.00
Excavation of loose rock	2,000 " "	.49	.49 " 1.00
Masonry faced one side	1,214 " "	5.45	5.45 " 14.40
Masonry in gate chambers	1,980 " "	5.84	5.84 " 20.00
Concrete filling	50 " "	1.45	1.45 " 6.00
Stone filling in cribs, unmortared	5,300 " "	1.48	1.48 " 6.00
Stone filling in cribs, in cement	3,600 " "	1.85	1.85 " 6.50
Rip-rap and stone walls	150 " "	1.10	1.10 " 5.00
Back filling of earth	500 " "	.28	.25 " .90
Placing of timber in dam	1,700 M.	7.45	6.00 " 13.50
Placing of plank in dam	48 "	7.45	6.00 " 13.50
Framing of gate lumber	86 "	28.00	14.00 " 40.00
Placing gears and castings	19 Tons.	19.00	15.00 " 30.00
Placing iron plate on crest of dam	21 "	14.00	10.00 " 30.00
Placing rack irons and penstock heads	40 "	21.00	15.00 " 30.00

Street Material.—The following proposals have been received by the City Commissioner, Baltimore, Md., for furnishing cobble and gutter-stone for repairs of streets for the year 1890: John G. Schwing, cobblestone, $1.48½ per perch; gutter-stone, 19 cts., per lin. ft. John Curley, gutter-stone, 20 cts. John Harris, cobblestone, $1.40; gutter-stone, 16 cts. David Leonard, cobblestone, $1.43¾; gutter-stone, 17¾ cts. Jas. H. Atkinson, cobblestone, $1.39; gutter-stone, 20 cts. B. Kepner, gutter-stone, 50 cts. The bidders and prices for furnishing flagstones and Belgian blocks, to be laid between the rows of flagstones, were: John G. Schwind, flagstones, 35 cts. per sq. ft. John Curley, flagstones, 25 cts.; blocks, $1.25 per sq. yd. John Harris, flagstones, 24 cts.; blocks, $1.25. David Leonard, flagstones, 28¾ cts. Jas. H. Atkinson, flagstones, 20 cts.; blocks, $1. B. Kepner, flagstones, 75 cts. per lin. ft.; blocks, $65 per 1,000. For furnishing iron gutter-plates, Campbell & Zell Co., 1 3-16 cts. per lb. Henry McShane & Co., 1¼ cts.; John Walz & Co., 1½ cts.; J. J. Lacy & Co., 1 7-16 cts.

Cement.—The contract for Portland cement for the Congressional Library building at Washington, D. C., has been awarded to M. M. Ruttenan, of New York, at $2.66. The list of bids was given last week on page 168.——The following proposals have been received by the U. S. Lighthouse Engineer, San Francisco, Cal., for 210 barrels of Portland cement: Henry Cowell & Co., San Francisco, $3.70 per barrel; H. T. Holmes & Co., San Francisco, $3.70; Charles Duisenberg & Co., San Francisco, $4.25. The contract was awarded to Henry Cowell & Co.

Filling.—The contract for filling miles 190 and 191 of the Lake Pontchartrain trestle, New Orleans & Northeastern R. R., has been awarded to R. H. Squair & Co., of Corinth, Ky.

Stone.—F. Widell, of Mankato, Minn., has a contract for $10,000 worth of dressed stone for the Minneapolis Mill Co.

Court House.—The Sinking Fund Commissioners, New York City, have received the following bids for the construction of the new criminal court building to be erected on the block inclosed by Centre, Elm, Franklin and White streets. J. & L. Weber were the lowest bidders, at $1,350,000, for the whole work, but the bids for the separate contracts amounted to $1,277,700, or $72,300 less than the Weber bid for the whole work. On this account the awards were made as follows: Dawson & Archer, masonry, $820,000; Jackson Architectural Iron Works, iron work, $284,925; P. K. Lantry, carpenter work, $161,000; James Fay, plumbing and gas fitting, $11,775. Ground will not be broken for the new building until March 1, and the contract stipulates that the work must be finished in 500 days.

Entire Work.	
M. S. Colman	$1,960,000
Samuel McMillan	1,577,000
James D. Murphy	1,518,000
J. & L. Weber	1,350,000
Mason Work.	
James D. Murphy	1,009,000
W. H. Arnott & Co	999,000
Moran & Armstrong	968,743
P. J. Conlin & Co	939,000
McCabe Brothers	909,900
Mahoney & Watson	898,500
Dawson & Archer	820,000
Iron Work.	
Jackson Architectural Iron Works	$284,925
Wallis Iron Works	285,000
Murray Hill Iron Works	309,999
Carpenter and Joiner Work.	
P. K. Lantry	$161,000
Mahoney Brothers	173,500
Smythe & Casey	175,880
Thomas Dwyer	184,000
P. J. Walsh	256,000

Plumbing, Drainage and Gas Fitting.

James Fay	$11,775
George Cody	13,331
Moody & Brocken	15,500
Houston & Corbitt	16,997
John Regan	17,443
Barrett & Jones	18,700
Thomas T. Burn	20,000
John Spencer	20,279
Christopher Nally	22,700
P. J. Andrews	24,000

Public Buildings.—A resolution has been introduced into the Rhode Island Legislature for a commission of five authorized to secure plans for a new capitol. They are to be given $25,000 to start with.

At a meeting of the trustees of Washington Academy, Salem, Mass., the committee on plans for the Bancroft memorial library building was instructed to have the plans, submitted by Sturgis & Cabot, architects, of Boston, completed at an early day. The cost of the building is not to exceed $18,000.

At Elkton, Md., bonds for $3,000 are to be issued for the erection of a new town building.

Elizabeth City Co., Va., has been authorized to issue bonds for the the purpose of providing funds for rebuilding the county courthouse.

The County Commissioners, Whatcom, Wash., have adopted the plans furnished by W. A. Ritchie, of Seattle, for the Whatcom County courthouse. It will be three stories high and built of Chuckanut stone. The contract for construction will probably be let to Mr. Ritchie's contractor also, at the price of $65,000 for the work. The commissioners had nineteen plans to choose from. Work will begin as soon as the weather permits, and the building will be completed before October.

Proposals for building a court house at Point-a-la Hache, La., will be received until March 1 by John Dymond, President of Police Jury, 41 North Peters St., New Orleans, La. Mr. Dymond has the plans and specifications.

PROPOSALS OPEN.

Lighting.—Lighting the streets by electricity or naphtha. S. H. Reed, Madison, N. J.

Bridge.—Highway bridge, substructure and approaches. Across Stone's River. The Chairman of the Board of Commissioners, Colonnade Building, Nashville, Tenn.

Cement.—About 600 bbls. of Portland cement. Maj. W. S. Stanton, U. S. Lighthouse Engineer, Post Office Building, Boston, Mass. Feb. 28.

Paving Blocks and Bricks.—Granite blocks; 300,000 blocks, 9 to 15 ins. long, 3½ to 5 ins. wide, 7 ins. deep. Average size 51 sq. ins. on top, making 25½ blocks per sq. yd. Faces and edges cut square. Paving bricks, 100,000. T. A. Huguenin, Superintendent of Streets, Charleston, S. C. Feb. 25.

Piles.—Furnishing 2,100 piles: 170 piles 75 to 85 ft. long, 17 to 7 ins. diameter at butt and point; 130 piles 70 to 75 ft. long, 14 to 6 ins. diameter; 350 piles 65 to 70 ft. long., 14 to 6 ins. diameter; 1,150 piles 60 to 65 ft. long, 14 to 6 ins. diameter; 300 piles 55 to 60 ft. long, 14 to 6 ins. diameter. The Docks Commissioners, Pier A, North River, New York City. Feb. 28.

Grading and Sewers.—St. A. D. Balcombe, Chairman, Board of Public Works, Omaha, Neb. Feb. 28.

Lighting.—Gasoline or electric lighting, including lamps and plant, for 3 years. James Griffin, Village Clerk, Madisonville, O. March 1.

Bridges.—Wood, iron or cable wire; over East Fork, 107 ft. main span; over Mussell Fork Creek, 112 ft. main span. John A. Lee, County Clerk, Keytesville, Mo. March 1.

Sewers.—Brick, 400 ft. of 18 × 27 in. Pipe, 43,802 ft. of 8-in., 2,452 ft. of 10-in., 2,985 ft. of 12-in., 2,891 ft. of 14-in., 2,702 ft. of 18 in., 396 ft. of 22-in. Manholes, 166. Catchbasins 21. F. Munchrath, Chairman of Sewer Committee, Sioux City, Ia. March 4.

Pier.—Repairing pier at W. 55th St., North River. The Docks Commissioners, Pier A, North River, New York City. March 5.

Hoisting Plants.—Two complete portable hoisting plants. James C. Duane, President, Aqueduct Commissioners, 280 Broadway, New York City. March 5.

Gate House.—Gate house superstructure, etc., for the gate chambers, at Croton Dam, on Section No. 1 of the New Croton Aqueduct. James C. Duane, President, Aqueduct Commissioners, 280 Broadway, New York City March 5.

Bridge.—Highway bridge, over the Dearborn Canal. J. S. Tooker, County Clerk, Helena, Mont. March 7.

Street Work.—Grading, widening and culvert. W. P. Rice, City Engineer, Cleveland, O. March 13.

Crib.—Crib foundation for dam across the Big Sandy River, near Louisa, Ky. Major D. W. Lockwood, U. S. Engineer Office, Cincinnati, O. March 19.

Embankment.—Extending the Great Miami embankment, at Lawrenceburg, Ind.; about 11,000 cu. yds. Lieut.-Col. Wm. E. Merrill, U. S. Engineer Office, Cincinnati, O. March 31.

MANUFACTURING AND TECHNICAL.

Plate Bending Machine.—The Niles Tool Works, of Hamilton, O., have finished an immense armor-plate bending roll plant that is to be sent to the navy yard at Mare Island, San Francisco. The machine weighs about 400,000 lbs., and the freight will be something over $10,000. The Cincinnati, Hamilton & Dayton has had a number of special flat cars built for the transportation of the load, and the whole train will be run through to the coast as a special.

Asphalt.—The Seattle Asphalt Co., of Seattle, Wash., has been incorporated by E. W. Andrews, W. F. Newell and W. T. Barton. Capital stock, $25,000.

Stone Crushers.—A crusher for macadam stone is wanted by the Graham Land & Improvement Co., of Graham, Va.

Ties.—The Combination Wood & Metal Tie Co., of Chicago, has been incorporated by J. F. Hoyt, M. Weston and W. J. Hoyt. Capital stock, $1,000,000.

Boilers.—The Carroll-Porter Boiler & Tank Co., for the manufacture of steam boilers, tanks, etc., has been organized at Allegheny, Pa. Capital, $50,000. The directors are James W. Porter, Sewickley; James S. McCord and D. W. C. Carroll, Allegheny.

Sewer Pipe.—About 35,000 ft. of 12-in. pipe are wanted by the Graham Land & Improvement Co., of Graham, Va.

Stone.—The Pittsburg Stone Co. has been organized at Pittsburg, Pa., for quarrying and selling stone. Capital, $50,000. Directors: Frederick H. Steele, W. H. Ginnis and Ross Drum, Pittsburg.

Cars.—The Litchfield Car Works, of Litchfield, Ill., are building 200 freight cars for the Mackey system.

The Indianapolis Car Works, of Indianapolis, Ind., have completed 450 of an order for 900 coal cars for the Pittsburg & Western.

The Pullman Palace Car Co., of Chicago, Ill., is building 11 vestibule cars.

The Barney & Smith Mfg. Co., of Dayton, O., is building 1,000 freight cars for the Northern Pacific. They will be fitted with the Janney coupler.

The Wagner Car Co., of Buffalo, N. Y., has turned out $176,000 worth of new work during January.

The Muskegon Car Co., of Muskegon, Mich., is building 300 cars for the Elgin, Joliet & Eastern.

The Peninsula Car Co., of Detroit, Mich., is building 500 freight cars for the Northern Pacific. They will be fitted with the Gould coupler.

The Minnesota Iron Car Co., of Duluth, Minn., has shipped some cars to the Cleveland, Akron & Columbus. They are standard 34-ft. box cars, 60,000 lbs. capacity. The body of the car does not differ from any first-class box car, but the sills are made of iron tubes instead of wood. These cars are from 1,000 to 3,000 lbs. lighter than wooden cars.

The Corey Car & Mfg. Co., of Chicago, Ill., has an order for dump cars for the Sudbury Copper Co., of Sudbury Ont.

Railway Material.—Rails, cars, etc., are wanted by D. J. McMillan, South Washington, N. C., for a standard gauge road 10 miles long.

Locomotives.—The Canadian Pacific Ry. shops have turned out 7 large engines and are to build 17 more engines for the Rocky Mountain divisions.

H. K. Porter & Co., of Pittsburg, Pa., are building a number of light engines for steel works and factories; also several steam street motors.

During the present year 57 new locomotives will be added to the rolling stock of the Pennsylvania southwest system. Of this number 18 are to be passenger engines of class "O" type. This is the latest designed locomotive on the Pennsylvania lines, and has been a success. The engines combine power and speed, and are used to haul the fast trains. There will also be 23 class "S," 10 class "R," 5 class "M" locomotives, and one heavy switch engine for Madison Hill. The class "S" locomotives and the switch engine are to be built at the Columbus shops. The 10 class "R" locomotives will be built by the Baldwin Locomotive Works, and the others at the Altoona and Fort Wayne shops. The class "R" engines are the heaviest freight engines in use on the Pennsylvania system, weighing 14,000 lbs. About 50 locomotives are to be added to the rolling stock of the Pennsylvania northwest system.

The Jeffersonville, Madison & Indianapolis will, within a short time, receive two more passenger engines of the class "O" type, and three of the old engines are being rebuilt after the same pattern. These engines weigh 98,000 lbs. without the tender, and are high-speed locomotives.

About 10 engines will be purchased by Watson & Co., Barnum, W. Va., for a tram road.

Car Works.—The shops to be built by the American Fire-Proof Steel Car Co., at Harvey, Ill., will consist of a main building 115 × 900 ft.; machine shop, 65 × 150 ft.; blacksmith shop, 65 × 200 ft.; store house, 50 × 250 ft., and foundry, 30 × 75 ft.

It is stated that $700,000 has been secured toward the capital stock of the company to build car works at Macon, Ga. The capital stock is to be $1,000,000. It is reported that the Georgia Southern & Florida R. R. is interested.

The Georgia Central R. R. has had plans prepared for the enlargement of its car shops at Macon.

Car works are projected at Americus, Ga. For particulars address Mr. J. A. Fort.

The Tripp Mfg. Co., of Boston, Mass., which is the sole manufacturer of the Tripp anti-friction bearings and Tripp's metallic packing, has removed to 180 Summer St., Boston, in consequence of an increase in business.

Asphalt Paving.—Trinidad sheet asphalt pavement on concrete foundation. Also curbing. T. J. Lanahan, Clerk of Board of Contract and Apportionment, Albany, N. Y., March 3.

The Cook Well Co., of St. Louis, Mo., has a number of orders on hand for deep well pumping machinery, and is enlarging and improving its factory, so as to increase its capacity to meet the demands.

Pole Railway.—Stone & Grier, of Beech Hill, Ga., will purchase a locomotive and cars for a pole railway.

Sewer Pipe.—H. A. Warner, of New Haven, Conn., has been awarded the contract for about 20 cars—some 15,000 ft.—of 8 to 15-in. vitrified sewer pipe, to extend the sewerage system at Torrington, Conn. Prices now are very low, and many towns are now availing themselves of this and placing orders.

Filters.—The National Water Purifying Co. reports contracts closed with the De La Vergne Refrigerating Machine Co., of New York, for 11 filter plants, to be used in connection with its refrigerating machines. Also with the Pennsylvania Steel Co., St. Lawrence Hall, Montreal (second order), and the Montreal Brewing Co. —The Morison-Allen Co. has opened offices at 145 Broadway, New York. The company manufactures improved water purifiers under patents awarded to O. H. Jewell, J. H. Jewell and Wm. M. Jewell.

Pumping Engines.—M. T. Davidson, manufacturer of steam pumping engines, 77 Liberty St., New York City, has been awarded the contract for Section 5 of the Brooklyn aqueduct extension. His bid of $76,400 was the lowest, being about $10,000 less than that of the next bidder. The work calls for the erection of four horizontal engines at Milburn pumping station. The fact that the Commissioner of City Works awarded the contract to him shows that his previous record in Brooklyn (he having previously furnished the city with 9 pumping engines), is considered as being satisfactory. The pumping engines proposed by Mr. Davidson are of his triple expansion type, patented in 1888, and one of which type, with a daily capacity of 5,000,000 gallons, has been running at the Jamaica Station for nearly one year at the unusual piston speed in a direct acting pumping engine of 200 ft. per per minute. This engine is said to work so quietly and smoothly at this speed as not to be heard at 6 ft. distance.

Aerated Fuel.—The Gilbert & Barker Mfg. Co., of Springfield, Mass., has assumed the general agency for the manufacture and sale of the fuel oil burners of the Aerated Fuel Co., of that city, for the whole United States. While continuing the erection of the Springfield gas machines, producing fuel gas for use in such of the lighter processes in the mechanical arts as it is specially adapted to, such as soldering, laboratory, jewelry, and similar light work, the company is prepared to erect plants complete for the use of crude petroleum and heavy oils of all kinds, as fuel for welding, tempering, annealing, brazing, forging, melting of metals and glass, etc. Fuel burners, storage tanks, air compressors, automatic steam pumps, pipe, valves, and all supplies needed for the construction, maintenance and repair of fuel oil plants, will be kept on hand.

Metal Market Prices.—***Rails.***—New York, $35 to $35.50; old rails, $26 to $26.50. Chicago: $37.50 to $38; old rails, $24 to $24.75 for iron and $20.25 to $21.50 for steel. Pittsburg: $35 to $36; old rails, $27 to $27.50 for iron, $23.50 to $24 for steel.

Track Materials.—New York: steel and iron angle bars, $2.10; spikes, $2.20 to $2.25. Pittsburg: splice bars, 2.10 to 2.20 cts.; spikes, $2.15, or $2.25 delivered at Chicago, Milwaukee, or St. Louis; track bolts, 3.10 cts. with square and 3.20 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel and 1.90 to 2 cts. for iron; spikes, 2.25 to 2.30 cts.; track bolts, 2.80 to 2.85 cts. with square and 2.95 to 3 cts. with hexagon nuts.

Pipe.—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 52½ per cent. discount.

Lead.—New York, 3.75 to 3.85 cts.; Chicago, 3.65 to 3.67½ cts.; St. Louis, 3.60 cts.

Barb Wire.—Chicago: 3.45 cts. for painted, 10 cts. off for carload lots. Galvanized 60 cts. per 100 lbs. more than painted.

Nails.—Pittsburg. At a meeting of the Western Nail Association a number of changes were made in the classification of the card for common cut nails. For some sizes prices were reduced, while others were advanced. The base sizes were changed from 12d to 40d to 50d to 60d, and the base price reduced from $2.50 to $2.25 in car lots, 60 days, 2 per cent. off for cash, or $2.35 for less than a carload. Wire nails have been reduced to $2.85, 60 days, 2 per cent off for cash, in carload lots.